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Thirtymile Fire Investigation Report

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Thirtymile Fire Investigation

Accident Investigation Factual Report and Management Evaluation Report

Chewuch River Canyon
Winthop, Washington
July 10, 2001

September 26, 2001

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Forest Service
U.S. Department of Agriculture

Accident Investigation Factual Report

Thirtymile Fire

Chewuch River Canyon
Winthrop, Washington
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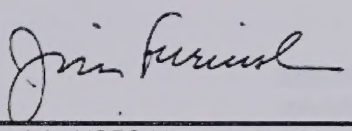
Forest Service
U.S. Department of Agriculture

Investigation Team
of the Thirtymile Fire

Team Leader



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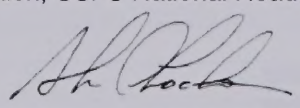

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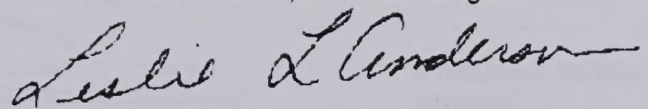

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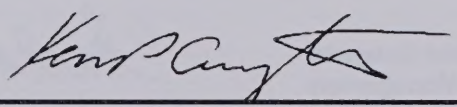

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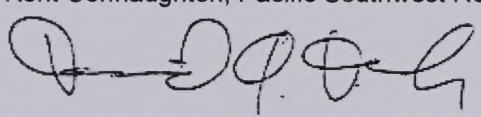

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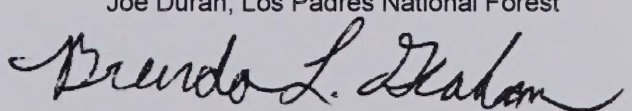

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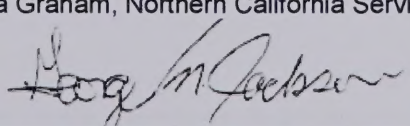

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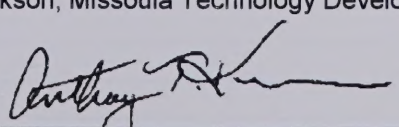

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In Memory Of

Tom Craven
Karen FitzPatrick
Jessica Johnson
Devin Weaver

And Dedicated To Those Who Will Be Saved

Prologue

The stillness of this place is eerie amidst the lingering smoke. The Chewuch River makes no sound as it glides by. Yet, there was violence here unimaginable to anyone who didn't witness the conflagration. Four people died here.

The charred surfaces of rocks are now calico cat-like from flaking, and boulders have been fractured by the heat. The conifers' small branches are frozen in time, needles intact, as they twisted away from the blast of the fire, and their trunks can't be blacker. Abandoned fire shelters lie scattered about on the ground and another glistens from the river bottom. The burned-out shell of a pickup truck sits on the road with windshield glass drooping over the dashboard and rivers of molten aluminum flowing away. This is a place that will long be remembered by the survivors and families of the deceased.

The investigation team spent many sobering hours here seeking to understand what happened and why, in hopes that a tragedy such as this will never happen again. We labored with respect and honor for those who died, and with a sense of duty to those who will face such a time in their life. We dedicate this report to the hope of lives saved.

Let there be no more purple ribbons.

Executive Summary

The Incident

On July 10, 2001, four Forest Service fire suppression personnel were killed after they became entrapped and their fire shelter deployment site was burned over by the Thirtymile Fire, in the Chewuch River Canyon, about 30 miles north of Winthrop, Washington.

The fire, an escaped picnic cooking fire, was detected on Monday, July 9th. Initial suppression activities began that evening. In addition, the Libby South Fire was already burning about 50 miles south of this area, and exceeded 1,000 acres. The Northwest Regulars #6 (NWR #6), a 21-person Type 2 crew from the Okanogan-Wenatchee National Forest, was dispatched to the Thirtymile Fire in the early morning hours of July 10th. They arrived about 9:00 a.m. in relief of the Entiat IHC crew who had been working on the fire overnight.

The area was enduring a lengthy drought and the moisture levels in large fuels were very low. The Energy Release Component, a measure of potential fire intensity, was near historic high levels for this time of year. Temperatures on July 10th reached nearly 100°F, and the humidity was very low. Although there was no dramatic shift in weather that would have created high winds, such as a dry cold front, up-canyon breezes were present to aggravate burning conditions. Fire conditions were potentially extreme.

By the late afternoon the fire advanced from its perimeter east of the Chewuch River toward the top of the east ridge. At this time, the NWR #6 was suppressing fires between the road west of the Chewuch River and the river itself. They were attempting to confine the fire to the east of the road. There were no personnel east of the river at that time since it had been determined that suppression activities there were fruitless. The NWR #6 crew took a break in mid-afternoon to eat, sharpen tools, and rest. About 4:00 p.m., they responded to a request from an Engine crew for help on a spot fire ¼ mile north of their position. They sent two squads to assist.

In the moments immediately prior to the entrapment, one of the squads and the crew boss trainee (a total of seven people) were working in association with a fire engine and its three person crew when a spot fire erupted right next to the road. The seven NWR #6 crewmembers and the engine crew immediately got in their vehicles and drove south past the fire along the east edge of the road to safety. While driving, they radioed the remaining 14 crewmembers who were working north, further up the river, of their dangerous situation.

The remaining 14 crewmembers (the Incident Commander and two NWR #6 squads) were actively suppressing spot fires between the river and the road about 1/4 mile north of the first squad when they were informed of the worsening situation that threatened their escape route. Immediately, 10 of the 14 got in the crew van and began to drive south. The other four preceded the van on foot. The van was driven past these four and approached the fire that was now burning across the road. The Incident Commander (IC) assessed the risk as too great to proceed.

He turned the van around, picked up the four crewmembers, all of the crew gear, and drove north upriver. The IC assessed different areas as potential safety zones or shelter deployment areas.

Approximately one mile north, the IC selected a site characterized by an extensive rock scree field above and west of the road. The Chewuch River and a sand bar were just east of the road. The site also had relatively sparse vegetation in the surrounding area. The NWR #6 crew unloaded and congregated on and above the road as they watched the fire. The van was turned around and parked on the side of the road next to the river.

Two civilians, a man and woman, arrived in their truck shortly after the crew. In the early afternoon they had driven to a campground near the road terminus about two miles beyond the deployment site. They had noticed the fire and suppression work while driving up the road to the trailhead. Later in the afternoon while resting they saw the smoke and decided to leave the area. No fire shelters or information about shelter deployment were made available to them when they encountered the crew.

Although observers had noted the approach of the fire, the crew was not prepared for the suddenness with which it arrived. A rain of burning embers was followed by a rolling, wave of tremendous heat, fire, smoke, and wind. Eight of the crew deployed their shelters on the road. The two civilians took shelter with one of crewmembers. One squad boss was high above the road on the rock scree observing the fire. He ran down towards the road, but could not get there before the fire arrived. He turned around and retreated back up the slope. Four crewmembers and another squad boss, who had been sitting on some large boulders above the road observing the approach of the crown fire, also retreated up-slope. These five deployed their shelters in the same vicinity as the squad boss. Four of the six people who deployed shelters in this rock scree field died.

The surviving squad boss and crewmember (who had no gloves) both left their shelters at some point when the fire abated to non-lethal levels. The squad boss fled down the rock scree field to the road and jumped in the river. The other survivor sought shelter from the radiant heat behind a large boulder for a few minutes. He then fled to the safety of the crew van. The crewmembers and the two civilians that had deployed on the road eventually relocated to the river when conditions allowed their safe movement.

After the passage of the fire, all but four crewmembers were accounted for. The rescue party arrived approximately 35 minutes after the shelter deployment. One crewman with severely burned hands was evacuated to a hospital in Seattle while the remaining injured were treated locally and released.

All four deaths were caused by asphyxia due to inhalation of superheated products of combustion.

Overview of the Thirtymile Fire Incident

Summary

On July 10, 2001, the Forest Service Northwest Regulars #6, a Type 2 fire crew, was entrapped by wildland fire. The fire, caused by an abandoned picnic cooking fire, was located 30 miles north of Winthrop, Washington, along the Chewuch River. Fourteen crewmembers and two civilians were involved in the entrapment. The civilians arrived at the entrapment site while trying to exit the area in their truck. Fourteen shelters were deployed. One shelter contained one Forest Service person and the two civilians. Six individuals, four of whom died, deployed approximately 100 feet upslope from the road. The remaining people, including the civilians, deployed on the road. After the initial deployment they relocated to the river. The civilians' vehicle was destroyed by fire. The Forest Service vehicle sustained minor damage, but was driveable. Ten Forest Service personnel and the two civilians survived the burnover.

The following is an overview of the events and actions that took place related to the Thirtymile Fire Incident. This overview is based on interviews with over 40 individuals, and the analysis of dispatch logs, resource orders, medical records, weather conditions, fuel conditions, training records, and equipment performance. Additional detailed information that is relevant to the identification of causal factors that led to this incident is presented in the appendices and in the Findings Section of this report.

Initial Actions

Topography of the Chewuch River Canyon

- 3,346 foot elevation at the point of origin
- 3,356 feet elevation at deployment site
- ~3,300 feet elevation from the floor to the ridge line
- ~18,000 feet from east ridge to the west

On Monday evening, July 9, 2001, a Canadian Lead Plane (Bird Dog 8), returning to Canada after supporting the Libby South Fire (burning about 20 miles south of Winthrop, Washington), reported seeing a fire near the road along the Chewuch River about 30 miles north of Winthrop.[1] The report, received at 9:26 p.m., stated that "the fire covered two hectares or five acres with two spots ahead of it." Within thirty minutes a three-person initial attack crew and Engine #704 were dispatched to Action 103 (later named the Thirtymile Fire).[2]

The Chewuch River runs down a deep "V" canyon. Although there is little elevation change along the canyon floor, both sides of the canyon have steep slopes (70% to 100%). The southwest to northeast orientation of the canyon is in alignment with afternoon ridge top and up-canyon winds.

The initial attack crew arrived at the point of origin of the fire a few minutes after 11 p.m.

Thirtymile Fire
Vicinity Maps
OKANOGAN
National Forest
WENATCHEE
National Forest
WASHINGTON
Seattle
Olympia
Wenatchee
Ellensburg
Yakima
Spokane
Vancouver
Tonasket
Omak
Okanogan
Chopaka
Osoyoos
Nighthawk
Oroville
Loomis
Tonasket
Conconully
Riverside
Omak
Okanogan
Mazama
Winthrop
Twisp
Malott
WILDERNESS
OKANOGAN
Wilderness Boundary
Scree slope
West Slope
Fatality site
Chewack
Deployment site
Point of origin
Rock slump
East Slope
FS Road 5160250
To Winthrop
Entrapment site
Final Fire Perimeter
Final Fire Perimeter
4000
0
4000
8000 Feet
N

Fuel Conditions in the Chewuch River Canyon

Ladder fuels were abundant at the point of origin and on the east slope of canyon.

Fuels in the riparian zone on the canyon floor near the point of origin and throughout the canyon were dry enough to support surface fire and torching.

Crown fuels were dense and surface fuels were continuous on the slopes east of the river.

Crown fuels were discontinuous and surface fuels were less abundant on the rocky slopes west of the river.

They estimated the fire was burning in three to eight acres of heavy brush with flame lengths of two to four feet.[3] They could see two spots on the east side of the river, one near the river and another that was burning actively close to the east slope.[4]

It was later determined that the fire had started as the result of an abandoned picnic cooking fire.

The initial attack crew thought that the fire would grow and unless they could get water on the fire their efforts would be useless.[5] The initial attack crew boss then requested two engines, a Mark III pump, hoses, and at least a 10-person crew.[6] The initial attack crew had four bladder bags, hand tools and a chainsaw.

Engine #704 arrived at the fire about 15 minutes before midnight. The initial attack crew boss offered the Supervisor on Engine #704 the Incident Command (IC) of the fire. The Engine Supervisor refused the IC role since he felt it was beyond what he could handle, it was dark, and he did not know the country very well.[7] It was his assessment that the fire was "20 to 25 acres … with multiple snags and numerous candles." This revised estimate of the fire size and the view that "it will grow, hit the slope and get larger" was passed on to the Okanogan Dispatch by the IC.[8] It was decided to hold at the road until the Entiat Interagency Hotshots (Entiat IHC) showed up.[9]

Figure 1. Chewuch River Canyon and Point of Fire Origin

At about midnight when the Okanogan Dispatch asked the IC if the fire could be let go until the morning, he responded that the fire needed "to be taken care of tonight because if it hits that slope it is going to the ridge top."[10]

The Entiat IHC was to be located and sent to the fire after working the day on another fire near Spokane, Washington.[11] After bedding down for approximately 30 minutes at the Liberty High School near Twisp, Washington, about 10 miles south of Winthrop, the Entiat IHC was awakened around midnight and sent to the Thirtymile Fire.

Around 1:00 a.m. on Tuesday, July 10th, the Entiat IHC and a pick-up truck with two additional firefighters arrived at the scene.[12] The pick-up truck had a Mark III pump, wye gates, and over 1,000 feet of hose.[13] Although the IC offered pump support, the Entiat IHC Superintendent felt it was not necessary. As a result the three-person initial attack crew, Engine #704, and the pick-up truck departed at 1:30 a.m.[14] The Entiat IHC Supervisor assumed the role of IC a little after 1:00 a.m.

The Entiat IHC began lining the fire between the road and the Chewuch River.[15] Numerous spots were noticed on the east side of the river. The plan of attack was to cross the river, find the spots, and line them.[16]

The Northwest Regulars #6

During the early morning of July 10 while the Entiat IHC crew was fighting the Thirtymile Fire, the Northwest Regulars #6 (NWR #6), a Type 2 fire crew, was called up. The NWR #6 crew was made up of 21 individuals from two different Ranger Districts located in central Washington State. These were:

- the recently combined Lake Wenatchee and Leavenworth Districts (referred to as Lake Leavenworth)
- the Naches District

Eleven members of the NWR #6 crew were from Lake Leavenworth and ten were from Naches.

The crewmembers were contacted beginning just after midnight. They were to assemble in Leavenworth, Washington, and then drive to the Twisp Ranger

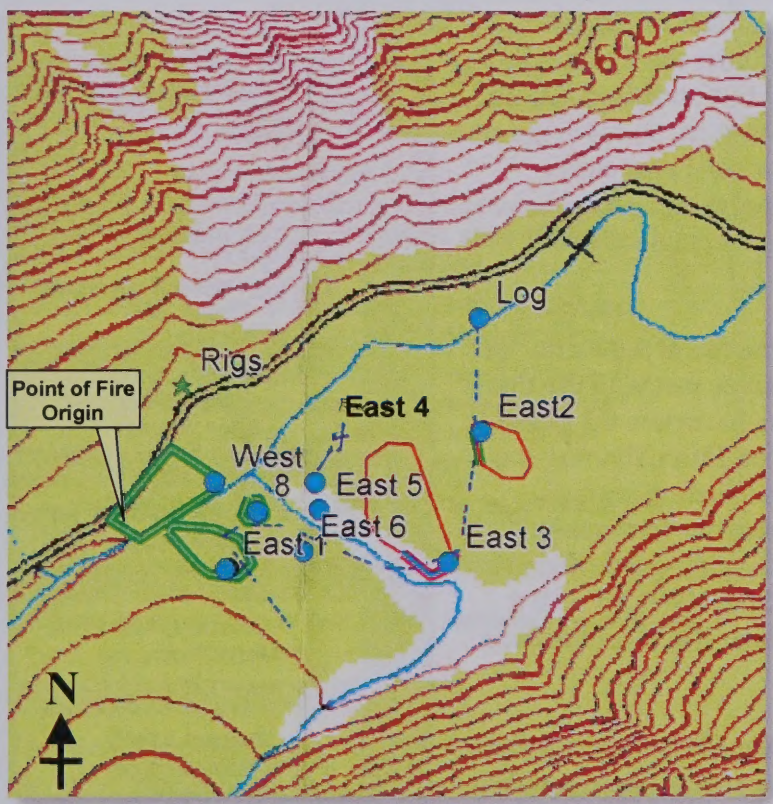
Northwest Regular #6 Type 2 Fire Crew

	Position	Home District
Ellreese Daniels	Crew Boss Trainer	Lake Leavenworth
Pete Kampen	Crew Boss Trainee	Lake Leavenworth
Squad 1		
Tom Craven	Squad Boss	Naches
Beau Clark	FFT2	Naches
Jason Emhoff	FFT1, EMT, FALB	Naches
Karen FitzPatrick	FFT2	Naches
Scott Scherzinger	FFT2	Naches
Rebecca Welch	FFT2	Naches
Squad 2		
Thom Taylor	Squad Boss	Lake Leavenworth
Armando Avila	FFT2	Lake Leavenworth
Nick Dreis	FFT2	Lake Leavenworth
Elain Hurd	FFT2	Lake Leavenworth
Jessica Johnson	FFT1	Naches
Matthew Rutman	FFT2	Lake Leavenworth
Devin Weaver	FFT2	Naches
Squad 3		
Brian Schexnayder	Squad Boss	Lake Leavenworth
Dewane Anderson	FFT2	Lake Leavenworth
Emily Hinson	FFT2	Lake Leavenworth
Jodie Tate	FFT1, EMT	Naches
Marshall Wallace	FFT1	Naches
Donica Watson	FFT2	Lake Leavenworth

Station for their briefing. They were informed they were being assigned to support the Libby South Fire.[17] The majority of the crew had as little as one or two hours of sleep before being called.[18]

When the Lake Leavenworth and Naches members of the NWR #6 crew met in Leavenworth around 3:00 a.m. they were organized into three squads.[19] One squad consisted entirely of personnel from the Naches District. The other two squads were made up of people from both ranger districts. Not all crewmembers knew the individuals from the other district with whom they would be working.

At 7:00 a.m., after about a three-hour drive from Leavenworth, the crew arrived at the Twisp Ranger Station to await their briefing. The NWR #6 crew was informed that they would not be going to the Libby South Fire. Rather, they would be assigned to do mop up on the smaller Thirtymile Fire. Many of the rookie crewmembers were disappointed.[20] Pete Soderquist and Elton Thomas, the District FMO and Forest FMO, respectively, accompanied the NWR #6 crew to the fire. The group arrived at the fire site just after 9:00 a.m.



Thick green & blue lines – lines completed between 1 a.m. and 10 a.m. on 7/10/01
Narrow red lines – projected fire perimeter
● – fire hot spots and crossing log locations

Figure 2. Status of Entiat IHC Containment Activities and GPS Mapped Hot Spots

The Entiat IHC Actions During the Night

The Entiat IHC began their actions to line the spots around 1:30 a.m. Within twenty minutes Marshal Brown, the IHC Superintendent, reported that they had completed a fireline from the road to the river.[21]

By 2:15 a.m., after containing two spots in the mostly "dog-haired" thicket, they moved across the river. Eventually they found a crossing log (noted in Figure 2) to allow easy access to the east side of the river. At that time, Okanogan Dispatch requested information on their resource needs for the morning. The Entiat IHC Superintendent, Marshal Brown, ordered a crew and an aircraft for the morning. He also ordered two Mark III

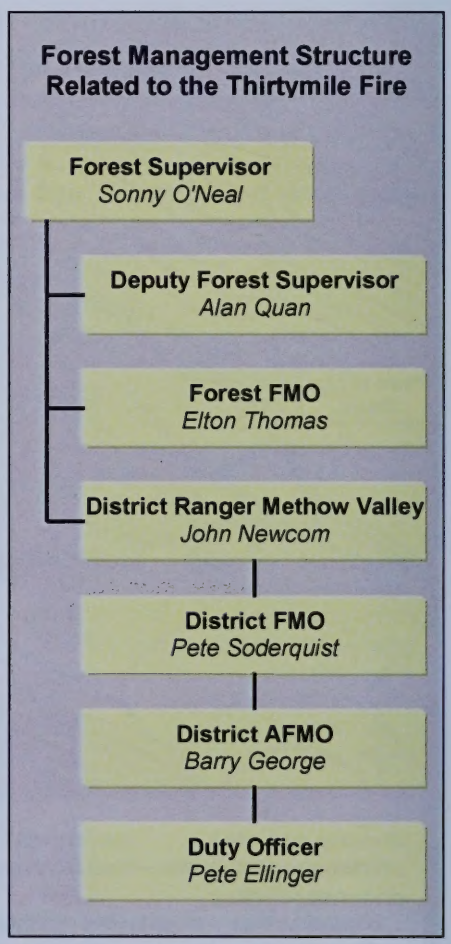
pumps with kits, 1,500 feet of hose, 10 wyes, 10 nozzles, and 10 reducers.[22] Confirmation was received three hours later at 5:26 a.m. that a Type III helicopter (Helicopter 13N) with a bucket and long line would be dispatched for arrival at 10:00 a.m. at the North Cascade Smokejumper Base (NCSB), located about 35 miles south of the fire site.[23]

By 5:30 a.m. there were seven spots on the east side of the river covering about five to six acres. Two spots were estimated to be about one acre each.[24]

The Entiat IHC took a break between about 5:30 a.m. and 6:30 a.m. to eat and rest. After the break they continued to work on the east side of the river digging a containment line and surrounding the spots until the NWR #6 crew relieved them. When they returned to the east side after 6:00 a.m. they noted that the "fire intensity had died down a lot."[25]

Transition to NWR #6

On the morning of July 10th, nearly all personnel on the Thirtymile Fire were suffering some effects of mental fatigue due to lack of sleep. This includes the Entiat IHC, the NWR #6, and key District and Forest personnel. As the day progressed, these effects would worsen, and provide one potential explanation for loss of situational awareness, compromised vigilance and decision-making. (A more detailed account of the fatigue factor is contained in the Human Factors Appendix.)



When the NWR #6 crew arrived at the fire at 9:04 a.m., the NWR #6 Crew Boss Trainer and Trainee met with the Entiat IHC Superintendent, Marshal Brown, to review the situation. Pete Soderquist, the District FMO, and Elton Thomas, the Forest FMO, also participated in this situation review meeting. This review meeting lasted about 45 minutes.[26]

At that time the Entiat IHC provided the NWR #6 with a GPS map of the hot spots and the Entiat IHC's containment activities (see Figure 2).[27]

Ellreese Daniels and Pete Kampen, the NWR #6 Crew Boss Trainer and Crew Boss Trainee, respectively, were shown the hot spots by Kyle Cannon, the Entiat IHC Assistant Superintendent. It was determined that the highest priority was spots 3 and 4 on the east side of the river (see Figure 2).[28] The tactics were to get the pumps going early and get water on the fire, cool it down, and have the crew mop it up.[29]

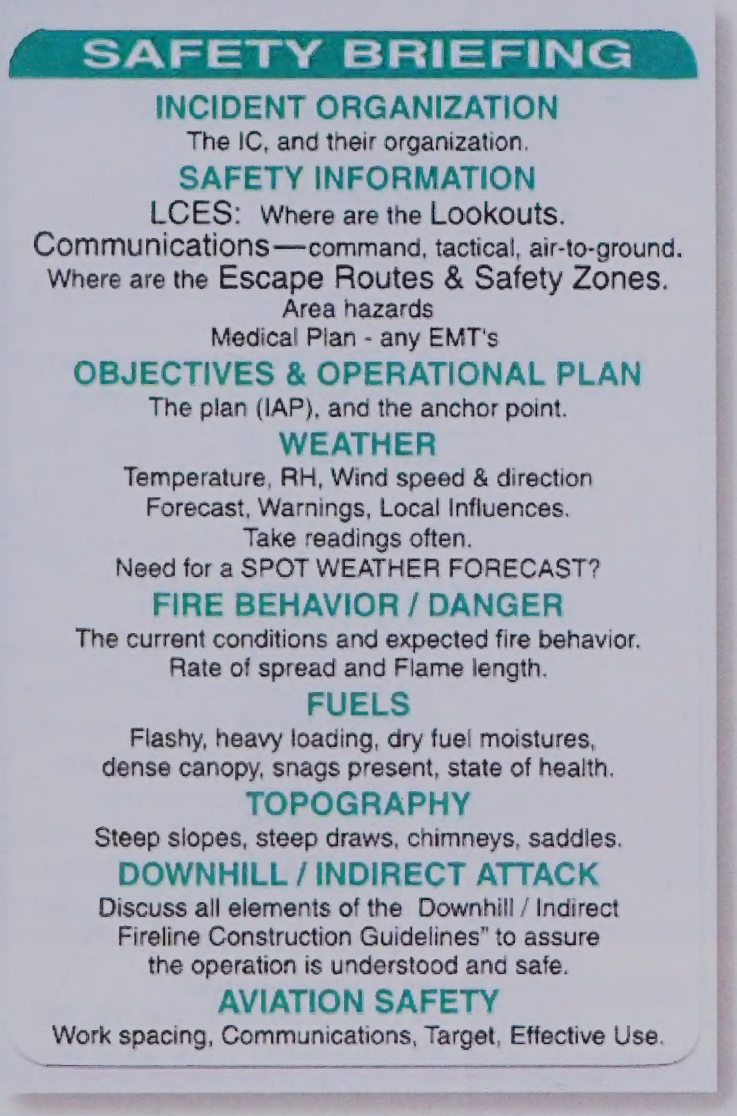
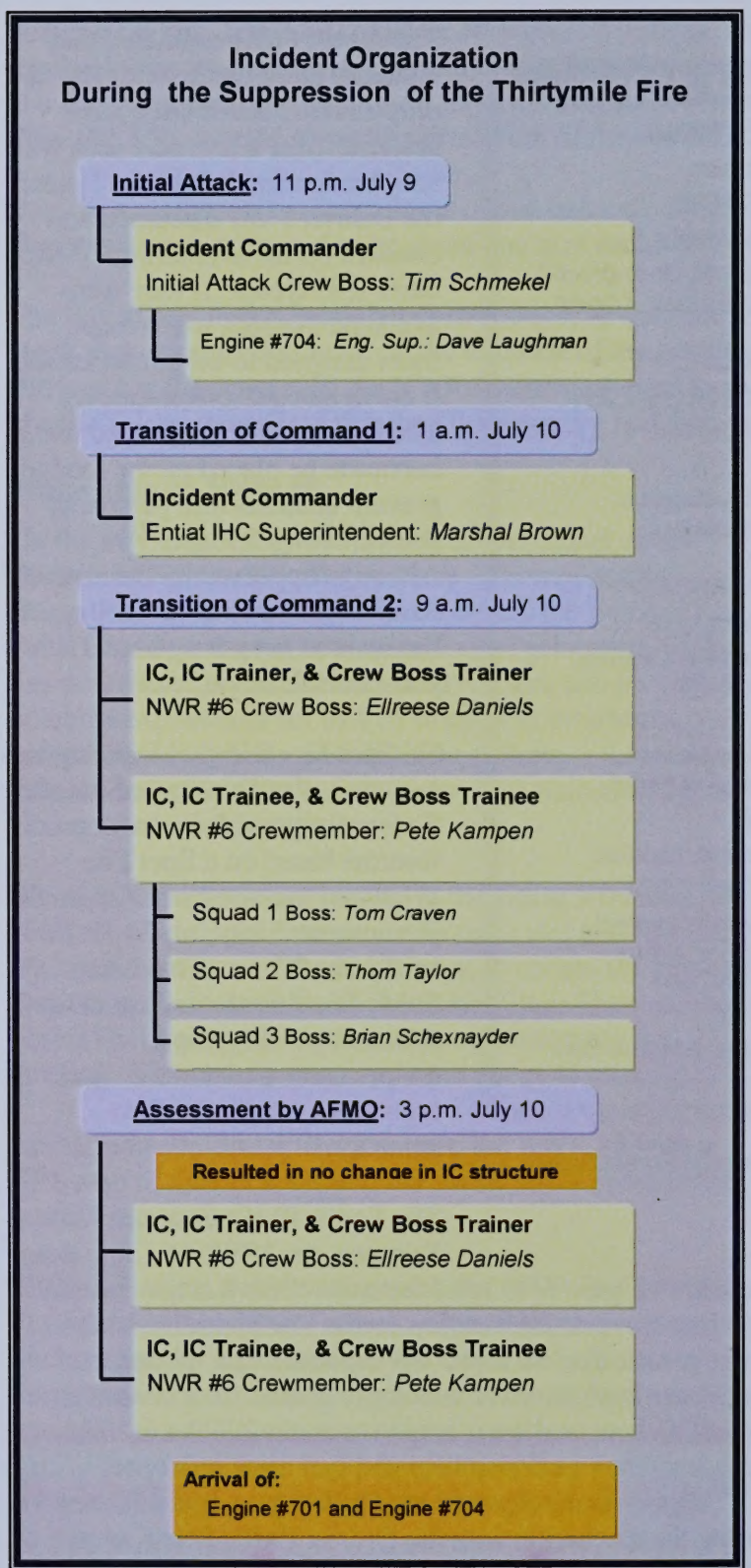


Figure 3. Okanogan & Wenatchee National Forest Safety Briefing Card

The Forest FMO estimated that although there was a lot of fire, it only covered about three acres scattered over a five acre area with very benign fire behavior. He and the District FMO discussed and checked on the availability of two other IHC crews. If they were available the plan was to have them assigned to the fire to knock it down and get it over quickly.[30] The District FMO requested that a barricade be placed on the road to prevent unauthorized personnel from entering the area.[31] Although approved by the District Ranger for the Methow Valley, the barrier was not put up until 3:17 p.m. that afternoon.

No Spot Fire Weather Forecast was issued for the Thirtymile Fire. Pete Soderquist provided a weather forecast based on a Spot Fire Weather Forecast for 6:00 p.m. the previous evening (July 9) for the Libby South Fire. This Libby South Fire forecast indicated low relative humidity, high temperatures and that the "fuel type was a trigger for fire behavior."[32]

The Forest FMO reminded Pete Kampen, the NWR #6 Crew Boss Trainee, to use the Safety Briefing Card (see Figure 3) to brief the crew. Pete Kampen briefed the three squads using the Libby South Fire forecast information on the low humidity, high temperature, and a predicted wind event greater than 10 mph. He explained that the tactics would involve using hose lays to bring water from the river and digging hand lines around the hot spots.[33] The briefing took about half an hour and was completed about 10:30 a.m. The NWR #6 crew was informed that this was a lot of work for them and that another 20-person crew was staged at Tonasket, Washington.[34] (Later in the day Air Attack found out that this crew would arrive about 8:00 p.m.).[35] During the discussion with the District FMO, Pete Kampen and Ellreese Daniels had been informed that the NWR #6 could expect support from Helicopter



13N for bucket work. The District FMO reminded them again just prior to departing for a Libby South Fire planning meeting.[36]

The NWR #6 crew had eight handheld radios. When Pete Kampen attempted to call Okanogan Dispatch he could not make contact. Ellreese Daniels, the Crew Boss Trainer for the NWR #6, was able to contact Okanogan Dispatch using his handheld radio. This was in contrast to the Entiat IHC situation where they had to use their mobile radio in their truck to contact Okanogan Dispatch.[37]

Pete Kampen and Ellreese Daniels agreed that Daniels would assume the role of the Incident Commander (IC) on the Thirtymile Fire and handle the communications. Kampen would manage the strategy and tactical decisions. Requests would be passed through Daniels to Okanogan Dispatch.[38]

At 11:00 a.m. the Entiat IHC left the fire site and drove about two miles downriver to bed down at a campground. Twenty minutes later Pete Soderquist and Elton Thomas departed for the Libby South Fire ICP.[39]

After the NWR #6 crew completed the safety briefings, the pumps were set up and the crew crossed the log to the east side of the river and began to apply water to the fire and dig line at about 11:00 a.m.[40]

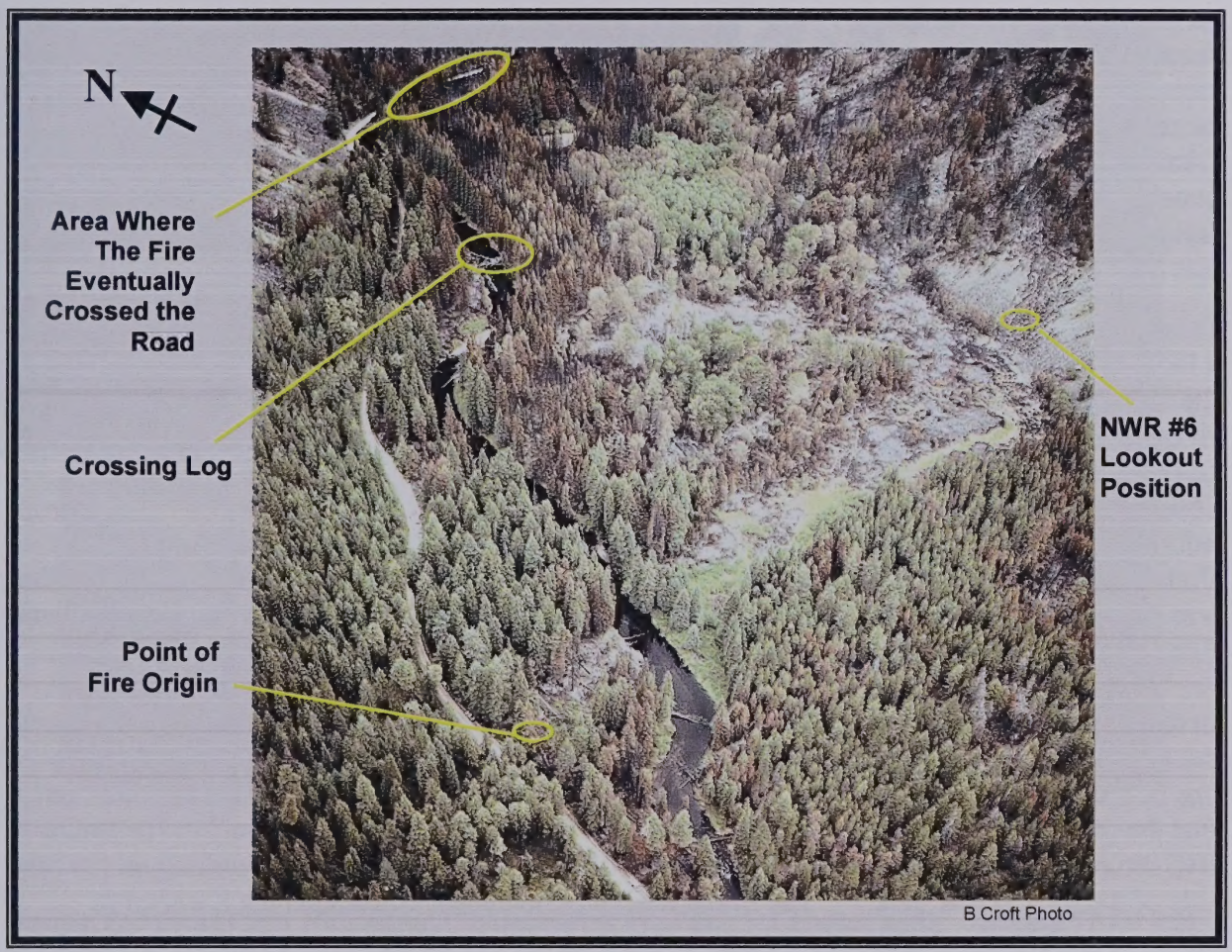


Figure 4. Area of Fire Activity from Evening of July 9th to 4:34 p.m. July 10th

By about noon the crew experienced several equipment-related problems:

- They had difficulties keeping the two pumps running, possibly due to improper use of pressure relief valves, and lack of experience with pumps and hoses.
- Several hoses burst. Some felt that the hoses were old and the pump was "picky."(41)
- At least four pulaskis broke during operations on the east side of the river. One handle split and heads came off of the handles on three apparently new pulaskis.(42)

The Crew Boss Trainee, Pete Kampen, decided to change tactics and dig a line to pinch the head of the fire. Jodie Tate, who had been operating the pumps was pulled off to dig lines.(43) The fireline construction was difficult with a lot of roots.(44) Some crewmembers realized they were digging line ahead of the fire and knew it was a "watch-out" situation.(45)

At 12:08 p.m. Pete Kampen requested that Helicopter 13N be launched.[46] Twenty minutes later he requested additional crews from Okanogan Dispatch. Daniels considered it unusual for green foliage to be burning as it was for this time of year.[47]

Safety Zone

An area cleared of flammable materials used for escape in the event the line is outflanked or in case a spot fire causes fuels outside the control line to render the line unsafe. In firing operations, crews progress so as to maintain a safety zone close at hand allowing the fuels inside the control line to be consumed before going ahead. Safety zones may also be constructed as integral parts of fuel breaks; they are greatly enlarged areas which can be used with relative safety by firefighters and their equipment in the event of blowup in the vicinity.

Source: Fireline Handbook

Donica Watson had been posted as a lookout on the rock scree above the crew on the east side of the river (see Figure 4).[48] She was responsible for taking weather observations and relaying information to Ellreese Daniels. As the fire behavior began to intensify, Daniels removed her from the rock scree sometime after 2:00 p.m. because of poor access to the escape route.[49] She was reassigned back to her squad. At this time Air Attack became the lookout for the Thirtymile Fire.

In response to the request for additional crews, the Okanogan Dispatch had attempted to contact the Entiat IHC. Since the Entiat IHC had not been contacted by 1:00 p.m., Pete Kampen sent one of the NWR #6 crewmembers to wake the Entiat IHC. The Entiat IHC Superintendent felt that the crew required more sleep and did not wake them until around 1:30 p.m.[50] The Entiat IHC returned to the fire around 2:00 p.m. The NWR #6 crewmembers were working on the east side of the river at that time.[51] The Entiat IHC Superintendent contacted Pete Kampen to review the situation. A little later Kampen decided to pull the NWR #6 crew back across the river to the road. The fire had been burning through the hoses in several places and spotting over their containment line. Pete Kampen accepted the fact that they "had lost the fire."[52] At 3:00 p.m. the NWR #6 crew was pulled back to the lunch site "safety zone" on the west side of the river. There they joined the Entiat IHC crew and ate lunch, rested, watered, and sharpened their tools.

K. Cannon

Figure 5. Fire on East Side of River at 2:45 p.m.

The Air Support Actions

Several times during the morning briefing the District FMO had informed the NWR #6 crew boss

Figure 6. At the Lunch Site After 3 p.m.

trainee and trainer that Helicopter 13N would be available for bucket work. Around 12:00 p.m. the NWR #6 was notified by the Okanogan Dispatch that Helicopter 13N was available 5 miles south of Winthrop at the North Cascade Smokejumper Base (NCSB).[53] At 12:08 Pete Kampen (through Ellreese Daniels as his communications connection to Dispatch) requested that Helicopter 13N be launched with a bucket.[54]

When contacted at 12:30 p.m. concerning the estimated time of arrival, the Okanogan Dispatch indicated that the helicopter required permission to dip out of the Chewuch River.[55] (This area of the Chewuch River is a Research Natural Area, and the river is a habitat for endangered fish species).

Air Attack was diverted from the Libby South Fire to the Thirtymile Fire at 12:40 p.m.[56] About twenty minutes later Air Attack stated that there was a dip site available down the river and another one was two miles up the canyon. Okanogan Dispatch repeated that they could not use the helicopter until they got permission.[57] Permission was received at 2:00 p.m. to use the helicopter.[58] (A detailed review of the sequence of events related to Helicopter 13N is presented in the Management Findings Section.)

Helicopter 13N departed for the fire at 2:38 p.m. from 8-Mile Camp which was about 20 miles south of the fire.[59] Helicopter 13N began making water drops on small spots at the south edge

of the fire and continued to work until having to refuel around 4:15 to 4:30 p.m. Before refueling, the fire had spread up the east canyon walls. After returning from refueling, the pilot of 13N noted that the fire spread had moved back to the canyon floor with spotting on the west wall of the canyon.[60]

Air Attack ordered a single engine air tanker (SEAT) at 1:15 p.m. Around 1:40 p.m. Air Attack announced that the fire was getting active, growing, and additional crews and air support were needed soon.[61] A few minutes after 2:00 p.m. the SEAT flew over the fire and decided the canyon was tight. Although he did not think it would be of much help, the SEAT pilot dropped the load on a small strip of timber.[62] Air Attack decided to have the SEAT reload and hold.

At 2:34 p.m. Air Attack requested a heavy air tanker. About a half an hour later Tanker 62 was en route with an estimated arrival of 3:21 p.m. Also, at about 2 p.m., Ellreese Daniels ordered another tanker and a PBY.[63] Tanker 12 was diverted from the Libby South Fire and arrived at the fire around 3:40 p.m. It could only make two drops before it was out of flight time.[64] The PBY would have to stop at Omak Lake for water while en route to the fire.

Around 3:20 p.m., Air Attack reported that the fire had reached about 50 acres in size and was crowning and going to the ridge.[65] Within 15 minutes the fire had grown to 100 acres and was almost on the ridge.[66] Air Attack then requested two additional Type 1 or 2 tankers.
At 4:03 p.m. the First Butte Lookout reported that the Thirtymile Fire was forming its own

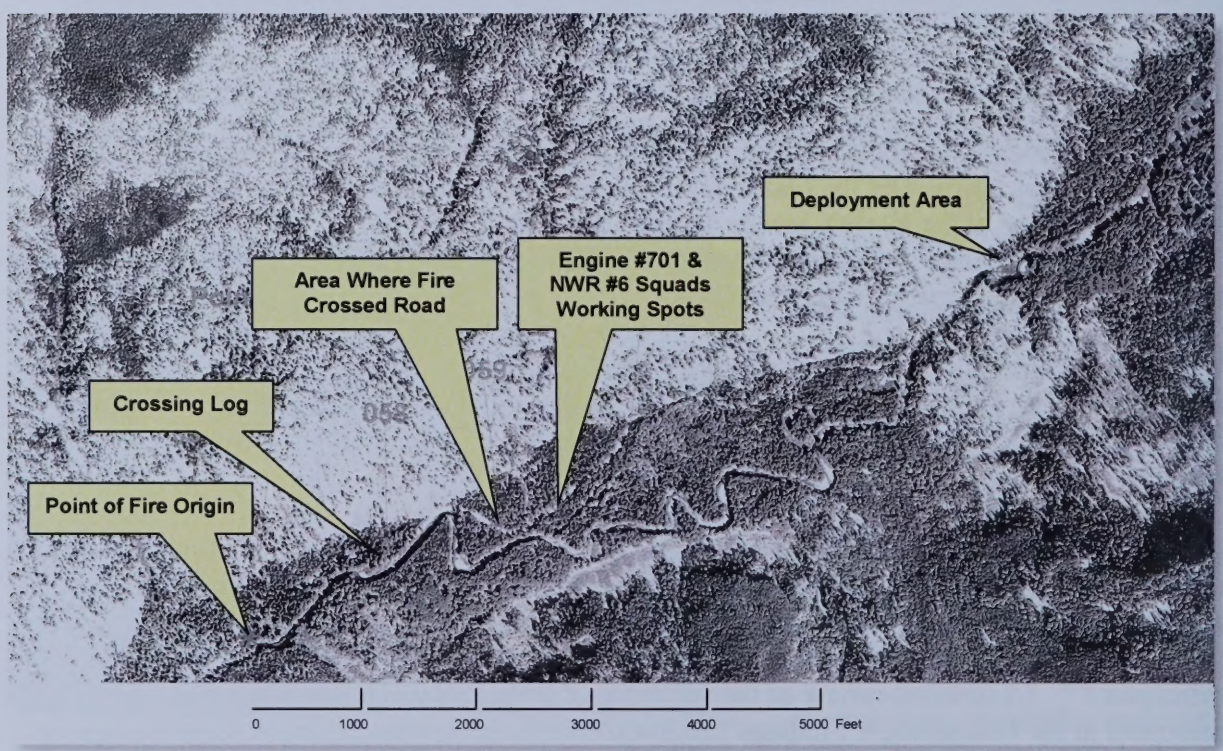


Figure 7. GPS Referenced Points from Fire Origin to Deployment Area

thunderhead.[67] By 4:18 p.m., Lead 66 requested the heavy tankers for the Libby South Fire. Both Air Attack and Lead 66 agreed that it looked like the Thirtymile Fire was going strong and it was moving in an uninhabited area. "It was not going to help throwing air tankers at it."[68] The tankers were diverted to the Libby South Fire. Helicopter 13N remained over the Thirtymile Fire dropping water.

Engines #701 & #704

At 2:27 p.m. Air Attack requested two engines. Engines #701 and #704 were then dispatched to the fire.[69] Initially Engine #701 had been assigned to work helispot, dust abatement, air crash rescue, and helicopter management at 8-Mile Camp 20 miles downriver from the fire.[70] According to Harry Dunn, the Supervisor on Engine #701, his mission from Okanogan Dispatch was to keep spots from the west side of the road.[71]

Engine #704 (a 4x4 pickup with a slip-on pumper) had been directed by the Duty Officer to put a "road closed" sign approximately one mile in from the end of the pavement on the Chewuch road. The sign was put up at 3:17 p.m. En route to putting up the sign Engine #704 was contacted by Okanogan Dispatch and requested to report to the Thirtymile Fire.[72]

The Supervisor of Engine #701 informed Engine #704 and three firefighters in a chase vehicle that their assignment was to keep the fire east of the road as per dispatch directions.[73] Around 3:30 p.m. both Engines #701 and #704 arrived on the fire scene. Neither checked in with the IC nor received a tactical briefing.[74]

Engines #701 and #704 drove past the Entiat IHC and NWR #6 crews and up the road to attack spots. They drove almost to the end of the road and then headed back down looking for spots. The plan was to have Engine #701 work the north section and Engine #704 work the south section. The spots near the road were thought to be "rather small at this time."[75]

Figure 8. Torching Across the River

The Entrapment

The NWR #6 and the Entiat IHC had lunch and rested at the "safety zone" while they watched the fire continue to grow. The District AFMO, Barry George, arrived around 3:00 p.m.[76] He met with Ellreese Daniels and discussed taking over the IC role. When asked by Barry George, Daniels said he was still comfortable with retaining the IC role.[77] George indicated that it would be nice to keep the fire east of the road. But there was no pressure, rather this would be a "nice to do" rather than a "have to do."[78] He suggested that the Entiat IHC Superintendent check out the campgrounds.[79] Marshal Brown and Kyle Cannon, the Entiat IHC Superintendent and Assistant Superintendent, respectively, drove to the end of the road and noted three cars at the trail head. They did not see the truck or the two civilians that would eventually drive down the road and be caught at the deployment site. On the way back they met Engine #701.

K. Cannon

Figure 9. View of Fire Crossing the Road from the Lunch Site Area Just After 4:34 p.m. (Entiat IHC and Engine #701 in foreground.)

Around 3:30 p.m. the District AFMO met with Ellreese Daniels and Pete Kampen to discuss their concern that the initial attack had not contained the fire.[80] Soon after that discussion Ellreese Daniels received a call from the Engine #701 Supervisor asking for help with a spot on the east side of the road. Ellreese Daniels and Pete Kampen evaluated the situation and decided to bring a squad up to support the Engine.[81] Pete Kampen dropped Ellreese Daniels and the NWR #6 Squad 1 (Tom Craven's squad) off at Engine #701. Kampen then returned to the lunch spot with the van. A few minutes later Thom Taylor, the Squad 2 Boss, was told by Kampen to take his squad up to support the Engines.

When Squad 2 reached the first engine they encountered, Engine #704, they were told their help was not needed.[82] They continue on up the road to Engine #701. Just after Taylor's squad arrived, Engine #701 left to work some spots further south along the road.[83] The two NWR #6 squads remained working spots about 100 feet to the east of the road.

Squad 3 was called to support Engine #704. Within 2 minutes of arriving at the location of Engine #704 the crew was ordered back in the van.[84] The fire was actively spotting and had moved right up to the east side of the road. The crew quickly drove back down the road to their lunch site "safety zone." Crewmembers from the NWR #6 Squad 3 had to shield their faces from the intense heat as they drove past the fire.[85]

At 4:34 p.m., as Squad 3 retreated, Kampen radioed Ellreese Daniels to get the people out of the area. NWR #6 Squads 1 and 2 were about ¼ mile further up the road from where Engine #704 had been working.

The crewmembers from Squads 1 and 2 dropped their gear and nine of them jumped into the van with Ellreese Daniels. The other four began running down the road.[86] As Daniels drove the van down the road he saw a "wall of flames", and he quickly turned the van around, picked up the other crewmembers and the crew gear, and drove about a mile up the canyon.

The Deployment Area

Ellreese Daniels evaluated three possible sites as he drove north, and with support from Air Attack, he selected the fourth site as the place were they could safely watch the fire pass them by.[87] It was characterized by extensive rock scree above and west of the road. The Chewuch River and a sand bar were just east of the road. There was relatively sparse forest vegetation in the surrounding area. The scree slope consisted of a jumble of six-inch to six-foot diameter rocks interspersed with woody debris and duff.

The NWR #6 crew unloaded and began to congregate on and above the road as they watched the fire. The van was turned around and parked on the side of the road next to the river.

There was no formal briefing given concerning possible deployment. At first everyone stayed on the road. After a while one of the squad bosses, Thom Taylor, and one of his crewmembers, Armando Avila, went up the scree slope to look for possible deployment spots.[88] Avila thought there was too much vegetation amongst the rocks and told Taylor that he was going back to the road with the others.[89]

Six of the ten crewmembers from the Naches District clustered together on two rocks about 30 feet above the road. Several times the IC told the people to come down from the rocks since the road was "the safe place to be."[90] Rebecca Welch left the Naches group on the rocks and returned to the road.

B Croft

Figure 10. The Road and Rock Scree Deployment Areas Looking West and Down River

By 5:00 p.m., Air Attack had estimated the fire to be over 500 acres. It was moving up the east canyon slope.[91] A few minutes after 5:00 p.m., two civilians, Bruce and Paula Hagemeyer, arrived at the entrapment site after having driven up the road earlier in the afternoon. The couple had been resting at the Thirtymile Campground and had become worried about the fire. No spare shelters or personal protective equipment were made available to the civilians.[92]

Deployment

At 5:24 p.m., the behavior of the fire changed dramatically. In spite of the lack of forest vegetation and brush in the immediate vicinity of the crew, the immensity of the fire overwhelmed the area and the crew. The abruptness of this change appears to have caught the crew by surprise. They were not in a heightened state of readiness. Shelter deployment was no longer optional but essential if any were to survive.

Crewmembers reported the fire was "coming very fast, roaring" and was preceded by ash and a "fire snowstorm."[73] The IC directed the crewmembers to "get your shelters out and use against the ash" in order to protect them from falling embers.[94]

Very quickly thereafter he told the crewmembers on the road to deploy -- some did not hear him due to the noise of the fire which sounded like a "freight train." Many found it difficult to deploy in the increasing wind.[95] Several of the crew deployed with their head facing the flames and with their backpacks on. Some deployed with their face up. Others dropped their backpacks right next to their shelters. At least one crewmember deployed without gloves. Neither of the civilians had gloves.

M Rutman

Figure 11. The Approaching Crown Fire

Thom Taylor had concluded that the rock slope was not a good deployment area and was coming down to the road when the fire column engulfed the site.[96] Thom Taylor was about 40 to 50 feet from the road when the flames came at him from across the canyon. He turned and ran up the slope before he deployed.

The Naches group on the rocks also ran up the slope when the column engulfed the site. They were right behind Taylor. Taylor deployed first and observed a group of five (Tom Craven, Jason Emhoff, Karen FitzPatrick, Jessica Johnson, and Devin Weaver) running uphill in front of the flames just prior to their deployment.[97] He yelled at them to deploy as he was getting into his shelter. They were unable to get further up the slope due to the rapidly deteriorating conditions.

The six deployed in a tight cluster among the rocks. The site where they deployed was about 100 feet above the road and had large, one to three foot boulders, with burnable, woody material imbedded in the rocks.

Conditions outside of the shelters at the deployment site on the road and in the rocks were lethal during the first minutes of the event. Within a few minutes, Thom Taylor was convinced that his shelter would not hold together long enough to save him.[98] He decided to run down the slope and jump into the river.

Figure 12. View Across the River Just Prior to Deployment

Jason Emhoff did not have gloves on and his hands were badly burned as he attempted to extinguish the flames within his shelter. He could not effectively hold the shelter down and decided to leave his shelter. After a few minutes he left his shelter and moved through the scree field trying to avoid the heat and flames. He eventually reached the road and got into the van. He avoided getting into the river due to his recent EMT training and concern with possible shock from the cold water.[99]

Prior to deployment, the civilians had time to put on long sleeved shirts, long pants, hats, and gather water and a towel. When the crew deployed, the civilians jumped inside the shelter with Rebecca Welch. They took the towel and a gallon of water into the shelter.[100]

Figure 13. The Scree Slope

The van sustained little heat damage. Only the license plate plastic frames were melted. The civilian's pickup caught fire during the burnover and eventually was completely destroyed.

While in the shelters the IC attempted to calm the crewmembers. He was in radio contact with Air Attack

throughout the entire deployment period and was monitoring the outside conditions. When it appeared safe he ordered everyone into the river. The crew joined Thom Taylor in the water. After about 15 minutes they moved to the sandbar.

The Rescue and Evacuation

Following the burnover and deployment, the Entiat IHC, who were down the road, quickly organized for the rescue operation. The Entiat IHC EMT team was briefed on what to expect at the site, and prepared supplies and personnel for action upon reaching the burnover site. Due to the extreme heat and multiple fallen snags, two attempts were required to reach the deployment site.

Figure 14. Deployment Spot on the Road Between Two Packs that Burned

Pete Kampen and four of the Entiat IHC arrived about 30 minutes after the deployment. When they arrived the IHC Superintendent assumed control of the accident scene and remained until the scene was turned over to local law enforcement.

NWR #6 crewmember Jason Emhoff was found in shock with second and third degree burns; his hands were severely burned. Others had minor burns and smoke inhalation. The civilian woman had burned her hand climbing over a log while getting in the river. The EMT team provided immediate medical attention, wrapping Emhoff's hands and calling for an airlift for him. He was transported to a burn center in Seattle while the other injured people were treated locally.

K. Cannon

Figure 15. Pete Kampen with Medical Kit at the Road Deployment Site at 6:10 p.m. (Entiat IHC truck in the background)

The IC asked the Entiat IHC for assistance in checking on the people who had deployed on the rocks. This was not possible because the rock scree slope was too hot, with burning material and rolling rocks. The Entiat IHC Superintendent attempted to discover signs of life in the four shelters, but got no response. It was later determined that all four deaths were caused by asphyxia due to inhalation of superheated products of combustion.

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Investigation Findings

The Investigation Team identified a large number of findings based on their review of the events that led to the Thirtymile Fire fatality incident. As specified in the procedure established in the agency's Accident Investigation Guide (2001), the findings have been organized into four subject categories:

- Environment of the location of the incident
- Equipment involved in, or contributing to, the incident
- People involved in, or contributing to, the incident
- Management issues or principles associated with the incident

In addition, there were two critical moments in time—the *entrapment* of the 14 crewmembers, and the *deployment* of fire shelters. The entrapment occurred when the fire crossed the road and cut off the escape route for the 14 firefighters and the two civilians. Shelter deployment occurred when people got into their fire shelters.

For purposes of organization, the findings are displayed in three time phases relative to the entrapment and shelter deployment. Findings about events and situations that occurred *prior to entrapment* are described first. These are followed by findings associated with the *entrapment phase*, which includes everything between the moment of entrapment and the moment of shelter deployment. The findings conclude with the *deployment phase*, which includes everything from the moment of deployment until the crew was evacuated, effectively ending the incident.

Findings are defined as fact-based conclusions, or relevant facts themselves. The findings, taken together, should provide a complete understanding of what occurred. The goal of the Investigation was to speak to the needs of as wide an audience as possible; thus the Investigation Team sought to provide a comprehensive set of findings.

Summary of Significant Findings

Although there were many findings identified for each of the four subject categories, the investigation team identified a smaller set of findings that were considered to be of significant importance to understanding the underlying causal factors that are associated with this incident. The significant findings are listed below and also presented at the beginning of each subject category.

Significant Environment Findings

- The combination of weather (at or near historic extremes for temperature and relative humidity, and the extended drought in the region) and fuel conditions (complex fuels on the canyon floor, extremely low moisture content of both the live and dead fuels) created extraordinary circumstances for fire growth on July 10th.
- Potential fire behavior was consistently underestimated throughout the incident.

Significant Equipment Findings

In spite of the ready availability of water, relatively little water was applied to the fire during the initial attack phase. This was largely due to operational problems with pumps and hoses, as well as delays in availability of a Type III helicopter.

Significant People Findings

- The fatalities and injuries all occurred during fire shelter deployment. Failure to adequately anticipate the severity and timing of the burnover, and failure to utilize the best location and proper deployment techniques contributed to the fatalities and injuries.
- Leadership, management, and command and control were all ineffective due to a variety of factors, such as the lack of communication and miscommunication, fatigue, lack of situational awareness, indecisiveness, and confusion about who was in control.
- Two civilians were involved in the entrapment due to a failure to properly close a potentially hazardous area.

Significant Management Findings

- All 10 Standard Fire Orders were violated or disregarded at some time during the course of the incident. (See on Standard Fire Orders Section, page 40)
- Ten of the eighteen Watch Out Situations were present or disregarded at some time during the course of the incident. (See Watch Out Situations Section, page 42)
- Records indicated that personnel on the Thirtymile Fire had very little sleep prior to their assignments, and mental fatigue affected vigilance and decision- making.
- District fire management personnel did not assume incident command when the size and complexity of the fire exceeded the capacity of the NWR #6.
- The NWR #6 crew was dispatched for assignment to the Libby South Fire. When redirected to the Thirtymile Fire local managers assigned a qualified individual (Daniels) from the NWR #6 as Incident Commander (IC). Because there was no redelegation of duties he remained Crew Boss and trainer for Kampen. Thus Daniels assumed collateral duties as IC (responsible for communications) and Crew Boss trainer. Kampen viewed himself as both IC (responsible for strategies and tactics) and Crew Boss in a trainee assignment. Command roles on the Thirtymile Fire were unclear and confusing to those in command of the incident, to the rest of the crew, and to others associated with the fire.

Environment Findings

Significant Environment Findings

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Prior to Entrapment

Fuels:

1. The fuel moisture content of dead woody fuels (10 hour at 3%, 100 hour at 5%, and 1000 hour at 10%) were at historic lows for the day of the event (calculations based on weather data from First Butte Remote Automated Weather Station). The moisture content of the live fuels was generally less than 100% (based on measurements taken in the vicinity of Lake Chelan, Washington).
2. Ladder fuels were abundant at the point of origin, on the east slope of canyon, and throughout the canyon floor.
3. Fuels in the riparian zone near the point of origin and throughout the canyon were dry enough to support surface fire and torching throughout the evening of July 9th and into the morning of July 10th.
4. Crown fuels were dense and surface fuels were continuous on the slopes east of the river. Crown fuels were discontinuous and surface fuels were less abundant on the rocky slopes west of the river.

Weather:

5. Abnormally dry conditions were experienced for this time of year. The 2000-2001 winter was the second driest winter in the past 30 years.
6. The day of the event, temperatures reached 94° F and relative humidity reached a low of 8% on the Chewuch River canyon floor. These readings were consistent with the near record high temperatures in the area (101° F at the North Cascade Smokejumper Base) and near record low relative humidity (RH 5% at the North Cascade Smokejumper Base).
7. The National Weather Service issued twice daily Fire Weather Forecasts on July 10th. Okanogan Dispatch received these forecasts but did not transmit the afternoon forecast to the Methow Valley District or Thirtymile Fire personnel.

8. No Spot Fire Weather forecast was requested for the Thirtymile Fire. The Spot Fire Weather forecast from the previous evening for the Libby South Fire was used to brief NWR #6 crew.
9. All fire weather forecasts matched observed weather conditions for the incident area.
10. No Fire Weather Watches or Red Flag Warnings were in effect or required within existing policies.
11. On the day of the deployment, the weather pattern over the Pacific NW region consisted of a southwest flow aloft with weak disturbances embedded in that flow.
12. On July 10th atmospheric conditions were conducive to the formation and vertical development of fire columns. At Spokane, the mid-level Haines Index was a 6, the high level Haines index reached a 4 (predicted 3-4).
13. There was no site-specific data available to determine if an inversion existed over the fire.

Topography:

14. The SW to NE orientation of the deep "V" canyon aligned with afternoon ridgetop and up-canyon winds.
15. Slopes were steep (with slopes 70% to 100%) on both sides of the canyon. There was little slope or stream gradient on the canyon floor.

Fire Behavior:

16. The forest fuel types support crown fire behavior and the Chewuch River canyon had experienced "stand replacing" fires previously.
17. Torching and short-range spotting occurred within fuels on the canyon floor throughout the night and early morning.
18. At mid-morning, fire intensity increased with more frequent torching and increasingly longer spotting distances.
19. At about 3:20 p.m. the fire made a strong upslope run on the slope east of the river and was also approaching the road near the entrapment area.

Entrapment Phase

Fuels:

20. The area where the fire initially crossed the road contained closely spaced conifers and conditions were drier than conditions next to the river.

Weather:

21. With the exception of the fire-induced winds, there was no significant general wind pattern affecting the fire at the time of the entrapment.

22. On-site weather conditions (relative humidity, atmospheric instability, and temperature) were conducive to extreme fire behavior and large column development.

Fire Behavior:

23. Smoke limited visibility from the air during the entrapment.
24. The direction of the fire in the canyon floor was generally parallel to the road. At the location of entrapment the road became perpendicular to the direction of the fire movement up the canyon floor. The fire crossed the road in this area at 4:34 p.m.
25. Helicopter 13N observed a fire induced wind of 20 mph from the south at the time of entrapment.
26. The fire accelerated and gained momentum as it spread up canyon. Falling embers created numerous spot fires ahead of the fire on the canyon floor, and on both east and west canyon walls.
27. Numerous spot fires were propagated from falling embers.

Deployment Phase

Fuels:

28. Sparse fuels on the rocky area south of the deployment area lessened the surface fire intensity at the two deployment sites.
29. The deployment site on the rock scree slope was upwind from, and adjacent to, areas of trees and brush (Fuel Model 10) and consisted of rock interspersed with woody debris and duff.
30. The deployment site on the road was a smooth, level, dirt surface with some brush on both sides.
31. After the burnover at the deployment area, there were leaves and needles "frozen" (not burned) on the trees and bushes indicating the wind direction.

Weather:

32. High winds experienced during fire shelter deployment and burnover were fire induced and were estimated in excess of 50 mph.

Topography:

33. The shelter deployment area consisted of a road, a sandbar, and a river, with a rocky area to the south and a rock scree slope to the west.
34. Fire shelters were deployed in two sites: on the road and on the rock scree slope.
35. Ten people utilized the shelter deployment sites on the road. All 10 survived within their shelters. This site was flat and significantly lower in elevation than the rock scree slope.

36. The deployment site on the rock scree consisted of a jumble of six inch to six-foot diameter rocks. This site was about 96 feet west of the road surface and 25 vertical feet above the road in an area with a 25% slope.
37. The shelter deployment site in the rock scree was utilized by 6 crewmembers, 4 of whom died. The two crewmembers that survived left the site after being in their shelters two to three minutes.
38. The rocks on the scree slope became extremely hot and remained so for an extended period of time.

Fire Behavior:

39. Sparse fuels on the rock area east of the river and the presence of the river lessened surface fire intensity in the shelter deployment area.
40. At the time of the deployment there were crown fires on the slope east of river and on the canyon floor. Ember showers created numerous spot fires. Crewmembers reported large embers were falling in the area.
41. A crown fire in the canyon floor and the associated convection column moved rapidly through the deployment site. Individuals on the scene referred to the column "rolling over" or "falling."
42. Following the deployment, active crown fire activity continued approximately 4 miles up the canyon and uprooted hundreds of trees and consumed a 40-acre alder patch on the river flat.

Equipment Findings

Significant Equipment Findings

In spite of the ready availability of water, relatively little water was applied to the fire during the initial attack phase. This was largely due to operational problems with pumps and hoses, as well as delays in availability of a Type III helicopter.

Prior to Entrapment

1. Water handling resources were made available to the Entiat IHC at about 1 a.m. on July 10th but the IHC Supervisor released the following equipment and personnel:
    - Engine #704 (slip-on pumper on a 4wd pickup) and 3-person crew
    - Chase truck and 3-person crew plus 2 other people
    - Mark III pump, wye gates, over 1,000 feet of hose
2. At 2:15 a.m. the Entiat IHC Superintendent requested water handling equipment and an aircraft for morning delivery -- two Mark III pumps, 1,500 feet of 1½-inch hose, 800 feet of 1-inch hose, 10 wyes, 10 nozzles, and 10 reducers.
3. The water handling equipment arrived with the NWR #6 crew at 9:04 a.m., and was put in use at around 11 a.m. when the NWR #6 began work.
4. The delivery of water for NWR #6 fire suppression activities was ineffective because of an inability to keep the pumps running continuously.
    - The hose layout (e.g., arrangement, size of hoses, and pressure reducers) was not conducive to optimal water operations, and limited the amount of water that the crew applied to the fire.
    - At least three lengths of 1-inch hose were blown.
    - The pumps were not in continuous operation due to mechanical and/or operator problems.
5. The lack of a reliable and consistent water supply operation in conjunction with escalating fire behavior led to a decision to change the tactics from water suppression to direct hand line construction.
6. At least four pulaskis broke during operations on east side of the river. One handle split. The heads came off of three apparently new pulaskis.
7. Aviation resources were continuously over the fire from about 1:00 p.m. and there were no reported equipment malfunctions on any of the aircraft.
8. No vehicle problems were reported throughout the incident.

9. The following aviation resources were assigned mid to late afternoon on July 10th:
    - One Type III helicopter
    - One SEAT (single engine air tanker)
    - Two Type I Airtankers
    - One Type II Airtanker (PBY)
    - One Air Attack
    - One Leadplane
10. The NWR #6 crew had eight handheld radios. There were minor problems with some handheld radios, however there was adequate communications capability with incident personnel, assigned aircraft, and dispatch.
11. The Okanogan Forest Dispatch radio system tape recorder was not operational; therefore there are no voice-recorded tapes for July 9th and 10th.

Entrapment Phase

12. Fourteen firefighters were shuttled to support Engine #701 using two vans. One 11-passenger van remained at this site.

Deployment Phase

13. At least one firefighter deployed without gloves, and his hands received third degree burns. There were extra gloves at the deployment site. Post accident investigation found two pair of leather gloves in one of the fireline packs.
14. The civilians arrived in shorts, shirts, and sandals and decided to change into their own personal long pants, long sleeve shirts, and ball caps.
15. There were additional gloves available at the deployment site in individuals' fire packs.
16. Firefighters did not prepare the deployment sites nor remove shelters until deployment was imminent (when embers began falling).
17. Crewmembers made no mention of any difficulty in opening the plastic shelter bags. Some of the fire shelters bags had been modified per the safety alert (0151-2828 MTDC).
18. It was difficult for some firefighters to deploy their shelters due to strong, turbulent winds.
19. The fire shelter is designed to protect one person. However one of the shelters was used to protect a firefighter and two civilians. All three survived, two with minor burns.
20. Several crewmembers recalled from their fire shelter training that rockslides are potentially effective deployment sites.
21. The road was an effective deployment site. Shelters deployed in this area experienced either minor or no heat damage.

22. Some of the firefighters deployed in the light brushy fuels on the edge of the road. Smoke and fire were present inside these shelters. At least two people that deployed near light brushy fuels had minor burn injuries.
23. Contrary to training, some firefighters dropped their packs immediately next to shelters occupied by themselves or others leading to burns to the occupant of the shelter in at least one case.
24. Some of the firefighters deployed in ways contrary to current training, e.g., head toward fire and with packs (and fusees) inside shelter. The remains of a pack, including fusee slag, were found under the shelter of one of the deceased.
25. As per training, people on the road were communicating with each other while they were in their shelters.
26. Survivors on the road stayed in their shelters about 15 minutes. Then they moved to the river and used the shelters for protection from the embers.
27. Inspection of the shelters after deployment revealed several tears and abrasions. It can not be determined how this damage occurred due to the extensive movement of the shelters during and after the deployment.
28. The rock deployment sites were exposed to high levels of radiant and convective heat (in excess of 500° F) that led to rapid and significant damage to the fire shelters (delamination and the loss of portions of the reflective layer).
29. Fuels in the rocks, proximity to trees both below and adjacent to the deployment site, and the position of the site on a slope in a slight draw contributed to the more severe conditions present at the fatality site. Six people deployed in a 15 to 20 foot wide cluster in the rocks; four died, one was seriously injured, and one had minor injuries.
30. The two survivors of the upper deployment site got out of their shelters after two to three minutes. One of them proceeded directly to the river and the other sought shelter in the rock scree slope before moving to the van.
31. Cracks and crevices between the rocks made it impossible to keep heat, flames, and combustible gases out of the shelters. Although rock areas are identified as a suitable deployment site in training materials, the difficulty of obtaining an effective seal with the shelter in rough terrain with large rocks is not addressed.
32. Conditions outside shelters at both deployment locations were unsurvivable in the first few minutes of the event. Fusees ignited outside the shelters at both deployment sites (this occurs at about 375° F). Fire shelters offered survivable conditions to 12 people.
33. The crew van had minor damage (melted license plate frames, front and back). Conditions were survivable inside the van. There was no melting evident of any interior feature.
34. The civilian's truck with a fiberglass camper shell was parked about 75 feet up canyon from the crew van next to burnable fuels and was consumed by fire.

People Findings

Significant People Findings

- The fatalities and injuries all occurred during fire shelter deployment. Failure to adequately anticipate the severity and timing of the burnover, and failure to utilize the best location and proper deployment techniques contributed to the fatalities and injuries.
- Leadership, management, and command and control were all ineffective due to a variety of factors, such as the lack of communication and miscommunication, fatigue, lack of situational awareness, indecisiveness, and confusion about who was in control.
- Two civilians were involved in the entrapment due to a failure to properly close a potentially hazardous area.

Prior to Entrapment

1. At about midnight on July 9th, the Type 4 initial attack IC reported an estimated size of the fire and observed fire behavior. He reported to Okanogan Dispatch and the district duty officer, "it will grow tonight; will not hold; will hit slope and get larger."
2. The NWR #6 consisted of people from two ranger districts. People from each ranger district trained at two different basic 32 hour fire-training camps.
3. The Lake Wenatchee and Leavenworth Ranger Districts were recently administratively consolidated and they maintained separate district identities at both work locations.
4. The NWR #6 crewmembers were contacted beginning at midnight to be at the Twisp Ranger Station by 7:00 a.m. Some crewmembers slept in the vehicles on the way to the incident (averaged two to three hours of sleep).
5. When NWR #6 assembled, not all members knew each other -- two of the squads were a mixture of people from the two different districts.
6. The Forest's requisite briefing, utilizing the Forest safety briefing card, was conducted onsite as NWR #6 took over incident from Entiat IHC. The Forest developed this safety briefing card as a safety precaution, although there is no national standardized briefing format for Type 3 and Type 4 incidents in the NWCG Fireline Handbook, as there is for Type 1 and Type 2 incidents.
7. The NWR #6 crew was given a GPS map of the immediate fire area by the Entiat IHC. They were not given a map or aerial photos of the Chewuch River Basin.
8. Two civilians drove up the Chewuch River road in the early afternoon, passing the fire and fire personnel en route to the Thirtymile Campground. There was no contact between the firefighters and the civilians at this time.

9. At approximately 2:45 p.m. the fire grew to more than 100 acres as it expanded up the east canyon wall. The IC trainer and IC trainee acknowledged that they had "lost the fire" but did not modify safety practices (escape routes, safety zones) or change tactics after moving back to the west side of the river.
10. At approximately 4:00 p.m., Engine #701 attacked a spot fire near the road about 1/2 mile up the canyon from the lunch site. Engine #701 requested and received assistance from NWR #6 squads 1 and 2. In the absence of changed tactics, Engine #701 received the assistance of the IC and the two squads.
11. While NWR #6 crewmembers and Engines #701 and #704 worked on spot fires along the east side of the road, Air Attack provided fire size information to the IC. This information was not passed along to the crewmembers.
12. Lookouts were not posted to monitor the fire while the NWR #6 crew worked on the spot fires on the east side of road after the 3:00 p.m. lunch break.
13. The District AFMO relayed to the IC that previous fires had crossed the road and burned both sides of the canyon.

Entrapment Phase

14. Air Attack informed the IC that there were spot fires west of the road at 4:34 p.m.
15. When confronted by a wall of flames across the road, the IC decided not to drive through the fire. It was too late to get through and not everyone was in the van -- ten were in the van and four were on foot. All the crewmembers and their gear were then loaded into the van and the group retreated up the canyon away from the fire.
16. The IC evaluated three different sites on their way to the selected "safe area", concluding that none of them afforded adequate protection in the event of deployment.
17. The crew took no action to improve the prospective deployment site; the IC decided not to improve the site as he thought the road was adequate.
18. There was nearly continuous communication between the IC and Air Attack about the fire behavior and conditions in the deployment zone.
19. While in the deployment area some people were socializing, some felt safe, and some were scared. Some crewmembers reported "hanging out," "taking pictures," "watching the show," and making journal entries.
20. Six of the eight Naches Ranger District crewmembers at the deployment site clustered together. They sat on a rock about 30 feet above the road. One Naches Ranger District crewmember left the group of five in the rocks to join the people on the road because they "seemed calmer," the road looked like a safer place to be, and the IC said, "to come down."
21. One Squad Boss (Taylor) moved up into the rock scree to check on the fire and said to the IC, "This is a good place to deploy. I'm going to stay up here." He eventually changed his mind and thought the scree slope was not a good place to deploy. He briefly returned to

the road and recommend to the IC that the crew should prepare the road site for deployment. He then returned to the scree slope to observe the fire.

22. The IC attempted to bring separated crewmembers back to the group by warning and instructing -- at least three times -- to leave the rocks (as that was not the place to be) and return to the road.
23. About fifteen minutes prior to deployment, two civilians arrived from the north (up canyon) in their pickup. They were met by two crewmembers and directed to the IC who told them to "stay calm." Prior to deployment the civilians had time to put on long sleeved shirts, long pants, hats, and gather water and a towel.
24. The civilians felt they were "largely on their own" although they remained on the road with the crew. The civilians reported that they were not "given advice on how to prepare or what to do." They "did not observe any effort to plan for deployment."

Deployment Phase

25. Crewmembers reported the fire was "coming very fast, roaring" and was preceded by ash and a "fire snow storm." The IC directed the crewmembers to "get your shelters out and use against the ash" in order to protect them from falling embers.
26. Winds increased and flames came over the river and the road. People on the road heard the IC yell, "deploy!" Many crewmembers relayed the call to deploy. People on the road deployed their shelters and dropped in place where they were.
27. Several survivors recalled and properly applied some information from fire shelter training prior to and during the burnover.
28. Six people deployed in the rocks at slightly different moments. Taylor deployed first and observed a group of five (Tom Craven, Jason Emhoff, Karen FitzPatrick, Jessica Johnson, and Devin Weaver) running uphill in front of the flames just prior to their deployment.
29. While in their shelters, the IC attempted to calm crewmembers. He yelled instructions to the crewmember that had the civilians in her shelter. Others talked, reassured each other, and prayed.
30. The two surviving crewmembers that deployed in the rocks initially heard others nearby praying, talking, and screaming. One of the crewmembers estimated that within one-two minutes he heard no more voices from those that deployed on the rocks.
31. Thom Taylor saw the upper left corner of his shelter begin to burn and fill with smoke. There were portions that had burned away. After about two to three minutes in the shelter he "ran through some flames down through rocks onto the road and jumped in the water."
32. Jason Emhoff had no gloves and could not hold onto the shelter because of his burned hands. He left his shelter after a few minutes and moved through the scree field to avoid the heat and flames. He eventually reached the road and got in the van -- he avoided the river due to his recent EMT training and his concern with possible shock from the cold water.

33. Air Attack and the IC maintained continuous communication during the deployment. Air Attack was also communicating with the Forest.
34. After approximately 15 minutes, the IC determined it was safe to emerge from the shelters, and encouraged by Taylor who was already in the river, directed the people to get in the river.
35. While in the river, the IC checked on the peoples' conditions, identified who was injured, and communicated this to Air Attack. After multiple head counts, the IC determined that four people were missing.
36. After the determination that several crewmembers were missing, there was a high state of anxiety and confusion as to what actions should be taken. Squad Boss Taylor then coordinated the rescue operations with the Entiat IHC Superintendent.
37. The Entiat IHC organized for the rescue. The Entiat IHC overhead, EMTs, and the NWR #6 Crew Boss Trainee made multiple attempts to get to the deployment site. They turned back at least once due to heat from the fire and had to remove several trees that had fallen across the road. They arrived at the site about 30 minutes after the deployment.
38. Upon arrival the Entiat IHC Superintendent assumed control of the accident scene and remained until the scene was turned over to local law enforcement.
39. Air Attack initiated off-incident emergency medical response and notification by contacting Okanogan Dispatch.
40. The NWR #6 and Entiat IHC EMTs provided initial triage and medical attention to four crewmembers and one of the civilians.
41. The IC (Daniels) asked the Entiat IHC for assistance in checking on the people who had deployed on the rocks. This was not possible because the rock scree slope was too hot, with burning material and rolling rocks. The Entiat IHC Superintendent attempted to discover signs of life in the four shelters, but got no response.
42. All four fatalities were from the Naches Ranger District.

Management Findings

Significant Management Findings

- All 10 Standard Fire Orders were violated or disregarded at some time during the course of the incident. (See Standard Fire Orders Section, page 40)
- Ten of the eighteen Watch Out Situations were present or disregarded at some time during the course of the incident. (See Watch Out Situations Section, page 42)
- Records indicated that personnel on the Thirtymile Fire had very little sleep prior to their assignments, and mental fatigue affected vigilance and decision- making.
- District fire management personnel did not assume incident command when the size and complexity of the fire exceeded the capacity of the NWR #6.
- The NWR #6 crew was dispatched for assignment to the Libby South fire. When redirected to the Thirtymile Fire local managers assigned a qualified individual (Daniels) from the NWR #6 as Incident Commander (IC). Because there was no redelegation of duties he remained Crew Boss and trainer for Kampen. Thus Daniels assumed collateral duties as IC (responsible for communications) and Crew Boss trainer. Kampen viewed himself as both IC (responsible for strategies and tactics) and Crew Boss in a trainee assignment. Command roles on the Thirtymile Fire were unclear and confusing to those in command of the incident, to the rest of the crew, and to others associated with the fire.

Note: Additional findings noted below with an asterisk (*) illustrate the fundamental finding that incident management was confusing and unclear.

Prior to Entrapment

1. All Forest personnel involved and those assigned to the incident had the required annual refresher training (standards for survival, LCES, and shelter deployment training) and work fitness testing.
2. * All personnel assigned to the fire were qualified for the positions they held, however there were a few crewmembers who perceived that the NWR #6 Crew Boss trainee was being promoted too quickly by being "fast tracked" (not a formal program).
3. The decision to suppress the fire was consistent with the Okanogan National Forest Land and Resource Management Plan and the standards and guidelines for the Chewuch River Research Natural Area.
4. It was the Lake Wenatchee and Leavenworth Districts and Naches District FMOs' practice in the crew formation process to emphasize mixing experience levels and ensuring there

was a chainsaw-qualified person per squad. Kampen followed this practice in organizing the crew.

5. * During initial action, about midnight, Engine #704 Supervisor was offered and declined incident command. He cited multiple concerns including size, complexity and inability to find good anchor points. This information was passed to Okanogan Dispatch (not known if this was passed along to District Duty Officer.)
6. During transition from District initial attack crew to the Entiat IHC at 1:00 a.m., additional resources (Engine #704, pumps, hose, and 7 crewmembers) were on scene and offered to stay and assist. The Entiat IHC Superintendent released the resources, but ordered similar equipment (and more) within one hour.
7. * At about 10:00 a.m. the Forest FMO requested that the road be closed. District management did not scout the road for civilian traffic nor close the road until after 3:00 p.m.
8. During transition from the Entiat IHC to NWR #6 the Entiat IHC Superintendent, and District and Forest Fire staff conferred and established mopping up spots east of the river as highest priority.
9. When Kampen briefed the crew he used the Forest's standard safety briefing card and the Libby South Fire spot forecast from 6:00 p.m. the previous night.
10. On July 9th and the morning of July 10th, the priority and focus of District Fire staff was on the Libby South Fire. The Thirtymile Fire was considered "basically a mop-up show."
11. The Okanogan National Forest 1997 Fire Management Action Plan states that a fire situation analysis will be prepared for any extended attack fire, although the 1995 national policy does not require this. No fire situation analysis was done on the Thirtymile Fire on July 9th or 10th. The Okanogan Fire Plan is currently being revised and is estimated to be completed in 2002.
12. The helicopter did not arrive at the fire in the morning as requested. The sequence of events was:
    - The Entiat IHC Superintendent ordered an aircraft and a crew at 2:15 a.m.
    - The Entiat IHC Superintendent ordered the aircraft for morning delivery.
    - At 5:26 a.m. Okanogan Dispatch contacted the Entiat IHC Superintendent to clarify the aircraft request. A Type 3 helicopter with long line, bucket, and reconnaissance capability was ordered.
    - At 5:30 a.m. Okanogan Dispatch ordered helicopter 13N from Wenatchee Dispatch for a 10:00 a.m. delivery time at North Cascades Smokejumper Base (NCSB).
    - Helicopter 13N (an exclusive local use resource based at Wenatchee) was not available until after 7:00 a.m. due to the pilot rest limitations. (The earliest the pilot could be legally contacted was 7:00 a.m. since he was on duty until 9:00 p.m. the previous night and required 10 hours of off duty time.)

- The IC was informed during the briefings (completed by 11:00 a.m.) by the Forest FMO that a helicopter would be available for their use.
- Helicopter 13N left Wenatchee at 9:53 a.m. and arrived at the NCSB at 10:30 a.m.
- At 11:52 a.m. Okanogan Dispatch notified the IC that helicopter 13N was available at NCSB.
- At 12:08 p.m. the IC ordered the helicopter 13N to be launched.
- The helicopter manager for 13N reported mid to late morning "...dispatch for the Okanogan called me to tell me to fly to the Thirtymile Fire." When the helicopter manager contacted the District AFMO about landing locations he was informed by the District AFMO that he "... didn't think we could dip water out of the Chewuch River because of environmental issues with salmon smolts." The District AFMO said he would "check into it."
- The helicopter manager contacted Okanogan Dispatch about where they could conduct dipping operations.
- At 12:30 p.m. the IC contacted Okanogan Dispatch and asked for the estimated time of arrival of the helicopter.
- At 12:42 p.m. an Air Attack was launched and a SEAT (single engine air tanker) was launched at 1:28 p.m. with water (not retardant).
- At 2:00 p.m. the District FMO approved the use of helicopter 13N.
- At 2:17 p.m. helicopter 13N was en route to the fire.
- At 2:35 p.m. 13N was at the helibase at 8-Mile Camp hooking up to their 75-gallon bucket.
- At 2:38 p.m. 13N left the helibase at 8-Mile Camp for the fire.
- The helicopter worked the fire until about 4:15 p.m. when it refueled and returned to the fire around 4:30 p.m.

13. The earliest that 13N could have been available was 9:30 a.m., if action had been initiated at 7:00 a.m. to start the pilot's duty time. This is 5 hours earlier than it actually arrived on the fire. This 5 hour difference is related to the following:

    - 13N arrived at NCSB at 10:30 a.m., and was available to the incident upon request by the IC.
    - IC Trainee (Kampen), through IC (Daniels) requested that 13N launch for the fire at 12:08 p.m.
    - For this request, there was no delay associated with endangered species considerations.
    - * Okanogan Dispatch sought to resolve concerns about dipping from the Chewuch River prior to releasing 13N. This took about two hours, and when the FMO was contacted he immediately gave permission at 2:00 p.m.

- There is no clear or consistent process on the Forest for helicopter bucket operations with respect to endangered species issues in relation to fire suppression operations.
- The Department of Interior memo (September 21, 1995) addressing endangered species considerations states that there are "no constraints...if they place firefighters in danger." It also states that "impacts to endangered species by helicopters during fire suppression activities have to be considered within the context of all other ground activities and the fire itself."
- * The District AFMO and ultimately the Okanogan Dispatcher were unclear on the appropriate course of action to take, delaying the release of the helicopter.

14. * The Incident Commander was not kept appraised of the status of orders, resulting in multiple repeat resource orders.
15. * Around 2:30 p.m. Kampen (the NWR #6 Crew Boss Trainee and IC Trainee) suggested to Kyle Cannon (the Entiat IHC Assistant Superintendent) that the Entiat IHC could take over the fire. Cannon declined and stated that "this is nothing we want to mess with either, we did not have any anchor, spots everywhere. There wasn't anything we could do."
16. * At 3:25 p.m. the District AFMO met with IC (Daniels) and asked if he was comfortable retaining incident command. Daniels agreed to retain incident command.
17. * After confirming that Daniels would retain IC, the District AFMO gave direction to others to check out the campground at the end of the road.
18. * Forest procedure as outlined in the Forest Mobilization Guide for "collaboration between Incident Commander and District Duty Officer" was not followed. The District AFMO, who was not District Duty Officer at that time, was on-site and provided strategic and tactical directions on the incident, such as the need to keep the fire contained on the east side of the road, but he did not take control of the incident.
19. Several individuals noted by 3:00 p.m. that the perceived "initial attack effort" had been lost. Containment was no longer possible with the on-site resources.
20. Around 3:30 p.m. the District AFMO met with Ellreese Daniels and Pete Kampen to discuss their concern that the initial attack had not contained the fire.
21. * The elements of fire complexity dictated a transition from initial to extended attack. The IC did not revise the strategy and tactics to address these changed circumstances.
22. * There was no clear distinction between the management of initial attack and extended attack in terms of policy or procedural requirements for tactical modifications, adjustments for safe practices, or changes in command.
23. * The IC did not request engines. The Air Attack ordered two engines about 2:30 p.m.
24. * Engine #701 was originally dispatched to work helispot, dust abatement, air crash rescue, and helicopter management. The Engine #701 Supervisor informed those on Engine #704 and the two firefighters in a chase vehicle that their assignment was to keep the fire east of the road as per dispatch direction.

25. * Between 3:24 and 3:27 p.m. Engines #701 and #704 arrived on the fire scene and did not check in with the IC or obtain a tactical briefing.
26. At approximately 4:00 p.m., Engine #701 attacked a spot fire near the road about 1/4 mile up the canyon from the lunch site. At this time, there was continuous unburned fuel between the lunch site and the spot fire. Engine #701 requested and received assistance from NWR #6.

Entrapment Phase

27. At approximately 4:34 p.m. the NWR #6 crew received direction from the NWR #6 Crew Boss Trainee (Kampen) and the Entiat IHC Superintendent to pull out and they complied.
28. The NWR #6 Crew Boss Trainee plus the six crewmembers of Squad 3 barely escaped as the fire began to burn at the edge of the road.
29. The IC (Daniels) and 13 NWR #6 Squad 1 and 2 crewmembers retreated south (10 in the van and four on foot) toward their lunch site, but their escape route was blocked by a wall of flames across the road. The IC then:
    - turned around, loaded all the crewmembers and their gear into the van, and retreated north up the canyon away from the fire
    - evaluated and rejected three separate rock scree sites as unsuitable
    - selected a "safety zone" (final deployment area)
30. It was later determined after the incident that the deployment area was not a "safety zone" because conditions were not survivable without deploying shelters.
31. The IC informed the crewmembers that the road was the safe place to be and repeatedly told those in the rocks above the road to come to the road. He was in constant contact with Air Attack and continually told the crewmembers and the civilians to remain calm.
32. * After arriving at the deployment site the crew dispersed to several locations:
    - Eight crewmembers (the IC and seven crewmembers) and the two civilians were on the road
    - Five crewmembers (one Squad Boss and four crewmembers) were on a couple of boulders about 30 feet from the road
    - One crewmember (a Squad Boss) was scouting up in the rock scree and eventually reached the conclusion that it was not as good a deployment site as the road
33. * The crew did not physically gather together on the road even after repeated directions by the IC.
34. * Although adequate time to prepare for shelter deployment was available, leadership did not prepare the crew for a possible burnover or initiate actions to control the situation.

Deployment Phase

35. After burnover, the IC directed the crewmembers out of their shelters and into the river.
36. Post-burnover rescue operations were well managed and coordinated by Entiat IHC.

Standard Fire Orders

All ten Standard Fire Orders were violated or disregarded at one time or another during the course of the incident. The following are some examples of these situations.

1. **Fight fire aggressively but provide for safety first.**

   The tactics implemented provided for aggressive suppression but lacked critical safety procedures, including mandatory escape routes.

2. **Initiate all actions based on current and expected fire behavior.**

   Aggressive attack with over-extended resources continued in spite of onsite indicators of an increased rate of spread, multiple spots, and crown fire.

3. **Recognize current weather conditions and obtain forecasts.**

   - Although received by Okanogan Dispatch, no afternoon fire weather forecast was transmitted to the Thirtymile Fire or the Methow Valley District.
   - No Spot Weather Forecast was requested by management or incident commanders.

4. **Ensure that instructions are given and understood.**

   - Instructions were given without any direct tie to strategy or tactics at the time of the entrapment.
   - At the deployment site instructions were given but not adhered to.
   - Instructions were coming from multiple sources adding to the confusion.

5. **Obtain current information on fire status.**

   - Air attack was utilized but due to smoke conditions could not always see the ground.
   - No assigned lookouts were used after 2 p.m.

6. **Remain in communication with your crew members, supervisors and adjoining forces.**

   Although the communication equipment was adequate, the lines of communications on the incident were poor due to lack of a plan and poorly established command structure. There was no viable strategy established during the afternoon of the incident.

7. **Determine safety zones and escape routes.**

   After the 3 p.m. lunch break, the crews were up canyon doing a frontal assault and had no alternative escape route or safety zone identified. They had nowhere to go when their only escape route was cut off.

8. Establish lookouts in potentially hazardous situations.

No lookouts were established during the burning period beyond what could be seen from the road and from air attack, who had limited visibility of the fire due to smoke.

9. Retain control at all times.

Leadership was fragmented and ineffective at all levels during the afternoon of July 10th. Resources were being ordered and directions given by others than the IC. While a suitable deployment site was found and orders were given there was no evidence of strong leadership on the deployment site to implement the orders as given.

10. Stay alert, keep calm, think clearly, act decisively.

- Supervisors, managers, and firefighters failed to stay alert and recognize changing conditions.
- Fatigue and collateral duties impeded the abilities of key leadership to think clearly and to act decisively to use available time on the shelter deployment site to prepare for the burnover.

Watch Out Situations

The following ten Watch Out Situations were present or disregarded at one time or another during the course of the incident as evidenced by the following non-inclusive set of examples.

Safety zones and escape routes not identified ***(Watch Out Situation # 3)***

- When they were working on the spots there was no clear instruction on safety zones or escape routes.
- The lunch site was not a safety zone and there were no safety zones up canyon from the point of the fire origin once the fire behavior became severe.
- The shelter deployment site was not a safety zone.

Unfamiliar with weather and local factors influencing fire behavior ***(Watch Out Situation # 4)***

- Fire fighters were unaware of the near record ERC readings and how that affected fire behavior.

Uninformed about strategy tactics and hazards ***(Watch Out Situation # 5)***

- Chosen strategy and tactics were not achievable or viable due to fuel and environmental conditions.
- Hazards were never properly recognized, evaluated, and addressed.
- It was not recognized that the tactics needed to be changed when the fire began to leave the riparian area.

Instructions and assignments not clear! ***(Watch Out Situation # 6)***

- Instructions were given without any direct tie to strategy or tactics at the time of the entrapment.
- At the deployment site, instructions were given but not adhered to.
- The incident commander did not make sure that all instructions were complied with.
- Many people throughout the incident gave instructions.

Constructing fire line without a safe anchor point ***(Watch Out Situation # 8)***

- When action was taken on the spot fires at the head of the main fire there was no secure anchor point.

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Denver, CO 80225

Attempting frontal assault on fire ***(Watch Out Situation # 10)***

- After the lunch break, two squads and two engines were actively suppressing spot fires ahead of the main fire.

Unburned fuel between you and the fire ***(Watch Out Situation # 11)***

- When engaged in suppression actions on the spots there was a large amount of unburned fuel between the main fire and the spots about 150 to 300 yards away.

Cannot see main fire, not in contact with anyone who can ***(Watch Out Situation # 12)***

- Air attack could not see the entire fire; no one could see the part of the fire that presented the greatest hazard.
- Terrain smoke and vegetation blocked firefighters view of the main fire.
- A look out who could continually view the main fire was not posted.

Spot fires frequently cross line ***(Watch Out Situation # 16)***

The NWR #6 crew experienced spots across their control lines from when they began work at approximately 11:00 a.m. on July 10th.

Terrain and fuels make escape to safety zones difficult ***(Watch Out Situation # 17)***

The identified safety zone did not satisfy the defined characteristics of a true safety zone.

Epilogue

The Investigation Team endeavored to provide meaning and context to this incident in the hope that our efforts will create a greater sense of urgency and commitment to safety. The Forest Service and all organizations involved in wildland fire suppression, and especially each individual, need to rededicate themselves to the fundamental principle that a choice for safety is the right choice—every time.

Rebecca Welch had little experience to draw on as she watched the approaching fire. Her only assets at this time were her judgment, her training, and the fire shelter itself. But at a critical moment she decided to leave her friends who were gathered in a rocky area and she went to the road in response to repeated requests and orders from the crew leader. There she positioned herself along the roadside, and moments later deployed her fire shelter, even sharing the precious space inside with two civilians, saving their lives as well. The simple choices she made had profound impacts on the lives of three people.

Safety is an uncompromising master. Most people compromise safety routinely in their daily activities, usually with no consequences. But neglect of safety eventually leads to "near misses," and near" misses lead to accidents, some with tragic consequences.

Fire suppression can be a dangerous business, and it has a history of tragic deaths. Safety and fire suppression need not be mutually exclusive, and safety must come first. We need to drive this message home with every agency, every crew, every manager, and every wildland firefighter involved in fire management and suppression.

The Investigation Team

Within hours of the incident an interagency team was being formed and the Occupational Safety and Health Administration was notified due to the fatalities of the federal workers. Jim Furnish, Deputy Chief for National Forest Systems, was designated investigation team leader. The investigation team first met in Twisp, WA on the evening of Wednesday, July 11.

The team investigated the fire and fatality site, and conducted interviews with people associated with the event. The team met daily in the morning and evening to discuss progress, review assignments, coordinate activities, review their findings, and document their work. The team adjourned July 23 with the bulk of the investigation and analysis done. Compilation and further refinement of the draft investigation report continued for the next few weeks, and the completed draft report was issued to the Management Review Board on August 23, 2001.

Thirtymile Fire Investigation Team Members

Team Leader	Jim Furnish USFS National Headquarters Washington, DC
Chief Investigator	Alan Chockie Link Technologies Seattle, WA
Equipment Specialist	Leslie Anderson USFS Missoula Technology & Development Center Missoula, MT
Line Officer Representative	Kent Connaughton USFS Pacific Southwest Region Vallejo, CA
Fire Operations	Dave Dash BLM-Alaska Fire Service Fort Wainwright, AK
Union Representative	Joe Duran USFS Los Padres National Forest Santa Maria, CA
Weather Specialist	Brenda Graham USFS Northern California Service Center Redding, CA
Equipment Specialist	George Jackson USFS Missoula Technology & Development Center Missoula, MT
Human Factors	Tony Kern USFS National Interagency Fire Center Boise, ID
Fire Behavior	Rich Lasko USFS Northern Region Missoula, MT
Weather Specialist	Jim Prange National Weather Service Seattle, WA
Operations	Jeanne Pincha-Tulley USFS Tahoe National Forest Nevada City, CA
Safety Manager	Chuck Whitlock USFS Missoula Technology & Development Center Missoula, MT

Thirtymile Fire Investigation Supporting Personnel

Logistics	Arnie Brosten USFS Flathead National Forest Suvan Lake Ranger District Big Fork, MT
Photographer /Videographer	Ben Croft USFS Missoula Technology & Development Center Missoula, MT
Okanogan-Wenatchee Liaison	Troy Corn USFS Okanogan-Wenatchee National Forest Entiat Ranger District Entiat, WA
Information Officer	Ron DeHart USFS Mt Baker-Snoqualmie National Forest Mt Lake-Tarrace, WA
Sociologist	John Driesen USFS Missoula Technology & Development Center Missoula, MT
Fire Behavior	Mark Finney USFS Rocky Mountain Research Station - Fire Science Laboratory Missoula, MT
GPS/GIS	Ron Gross USFS Okanogan-Wenatchee National Forest Twisp, WA
Fire Behavior	Tom Leuschen USFS Okanogan-Wenatchee National Forest Twisp, WA
Transcriptions	Gary Maddux USFS Tahoe National Forest Nevada City, CA
Law Enforcement Liaison	Bill McConnell USFS Colville National Forest Colville, WA
Documentation	Shari Miller USFS Okanogan-Wenatchee National Forest Wenatchee, WA

United States Department of Agriculture | Forest Service | Washington Office | 14th & Independence SW
P.O. Box 96090
Washington, DC 20090-6090

File Code: 6730
Route To:

Date: JUL 11 2001

Subject: Thirtymile Fire Fatalities Investigation

To: Jim Furnish, Investigation Team Leader

The Accident Investigation Team, being led by you, including a core team, technical specialists, and other necessary support staff, is delegated the authority to conduct an investigation of the fatalities and injuries that occurred during the entrapment and shelter deployment on the Thirtymile Fire, Okanogan National Forest, WA.

The Team shall:

1. Organize, conduct, and control the accident investigation;
2. Coordinate information exchange among team members, local Law Enforcement, coroner, etc.;
3. Maintain liaison with affected units;
4. Approve requests and allocate funding for necessary resources;
5. Report preliminary findings or other facts, as they become known, to the Chief on an on-going basis;
6. Furnish to the Chief all reports as outlined in the Accident Investigation Guide (6700 Safety and Health April 2001-0167-2825-MTDC);
7. Through a thorough analysis of accident sequence, human factors, and environmental factors determine:
    a. Direct causal factor(s) of fatalities;
    b. Contributing factor(s) surrounding the accident;
8. Adhere to the Information Flow Chart (enclosed);
9. The primary contact for the Office of Communication is Joe Walsh.

A separate Management Review Team will be appointed to review the accident reports and to develop proposed corrective actions that should be implemented to eliminate future accidents of this nature.

Dale N. Bosworth

DALE N. BOSWORTH
Chief

Enclosure

Thirtymile Fire Investigation

List of Individuals Interviewed

Name	Position
Dwain Anderson	NWR #6, Squad 3 Member
Bill Austin	Goat Peak Lookout
Armando Avila	NWR #6, Squad 2 Member
Mort Banasky	First Butte Lookout
Gary Bennett	Fire Weather Program Leader
John Birks	Squad Boss, Entiat IHC
Marshall Brown	Superintendent, Entiat IHC
Kyle Cannon	Member Entiat IHC
Beau Clark	NWR #6, Squad 1 Member
Ellreese Daniels	NWR #6, Crew Boss Trainer
Nick Dreis	NWR #6, Squad 2 Member
Harry Dunn	Engine #704 Supervisor
Sally Estes	Dispatch Coordinator, Okanagon National Forest
Jason Emhoff	NWR #6, Squad 1 Member
Barry George	ADFMO, Methow Ranger District
Bruce Hagemeyer	Civilian
Paula Hagemeyer	Civilian
Lyle Hammer	Meteorologist
Emily Hinson	NWR #6, Squad 3 Member
Elaine Hurd	NWR #6, Squad 2 Member
Gabe Jasso	Forest AFMO, Lake Wenatchee
Pete Kampen	NWR #6, Crew Boss Trainee
Dave Laughman	Engine #704 Driver
George Marcott	FMO Lake Naches RD
Eric Nichols	Firefighter (Timber)
John Newcom	District Ranger, Twisp
Sonny O'Neal	Forest Supervisor Okanogan-Wenatchee NF
Michael Pipgras	Member Entiat IHC
Alan Quan	Deputy Forest Supervisor Okanogan-Wenatchee NF
Gary Reed	Methow Valley Ranger District Duty Officer 7/10/01
Matthew Rutman	NWR #6, Squad 2 Member
Pete Soderquist	District FMO
Tim Schmekel	Engine #704 Assistant Supervisor
Scott Scherzinger	NWR #6, Squad 1 Member
Brian Schexnayder	NWR #6, Squad 3, Squad Boss
Ron Smith	Pierce Aviation
Jamie Tackman	Lead Pilot, Libby South Fire
Jodie Tate	NWR #6, Squad 3 Member
Tom Taylor	NWR #6, Squad 2, Squad Boss
Elton Thomas	Forest FMO
Marshall Wallace	NWR #6, Squad 3 Member
Roger Wallace	Fire Management Officer, Lake Wenatchee & Leavenworth RD
Paul Walters	Pilot, Helicopter 3913N
Donica Watson	NWR #6, Squad 3 Member
Rebecca Welch	NWR #6, Squad 1 Member

Incident Time Line

Event	Time/Date	Response Actions
Untended campfire ignites a fire along the Chewuch River Fire reported by Canadian Lead Plane (9:26 p.m.)	July 9 ,2001 — 9:00 p.m. — — 10:00 p.m. —	3-Person hand crew en route to fire (10:04 p.m.) Engine #704 en route to fire (10:45 p.m.)
Fire size estimated 3 to 8 acres in heavy timber with 2-4 foot flame lengths (11:08 p.m.) 10-person crew and 2 engines requested (11:08 p.m.) Fire investigator and Type 3 or 4 IC requested (11:22 p.m.) Fire size estimated 20-25 acres & "it will grow tonight, will not hold, will hit slope and get larger" (11:59 p.m.)	— 11:00 p.m. — — 12:00 a.m. — *July 10, 2001*	3-Person hand crew arrives at fire (~11 p.m.) Entiat IHC & Mark III pump assigned to the fire (11:11 p.m.) Engine #704 arrives at fire (11:49 p.m.)
NWR #6 crew assigned to Libby South fire (~12:00 a.m.) Fire "slopped over river" (12:10 a.m.) Entiat IHC releases Engine #704, 3-person hand crew & 2 person chase truck (~1:30 a.m.) Fire line completed from road to west side of river (1:48 a.m.)	— 1:00 a.m. —	NWR #6 crew contacted to meet in Twisp, WA at 7:00 a.m. Entiat IHC and 2-person chase truck arrive at fire (~1:00 a.m.) Engine #704, 3-person hand crew & 2-person chase truck depart the fire (1:30 a.m.) Plan of attack is to go east of river and find and line spots (~1:30 a.m.)

Event	Time/Date	Response Actions
	— 2:00 a.m. —	
2 spots contained (2:15 a.m.)		Entiat IHC move to east side of river (2:15 a.m.)
Crew and helicopter ordered for morning arrival (2:15 a.m.)		
2 Mark III pumps with kits, hose, wyes, nozzles, reducers ordered (2:15 a.m.)		
	— 3:00 a.m. —	
		NWR #6 crew assembles in Leavenworth, WA (3:30 a.m.)
	— 4:00 a.m. —	
	— 5:00 a.m. —	
Dispatch requested information on type of aircraft needed (5:26 a.m.)		Confirmed Helicopter 13N (Type III with bucket and long line) to be available at NCSB at 10 a.m. (5:26 a.m.)
Seven spots covering a total of 5 to 6 acres - five spots lined (5:26 a.m.)		Entiat move to west side of river for rest and food (~5:30 a.m.)
	— 6:00 a.m. —	
About 1.5 acres lined (6:26 a.m.)		Entiat IHC return to fire on east side of river (6:26 a.m.)
NWR #6 arrives at Twisp Ranger Station (~7:00 a.m.)	— 7:00 a.m. —	Briefing -- NWR #6 notified they would be mopping up "a small fire" (~7:00 a.m.)
NWR #6, District FMO, and Forest FMO depart for the fire (7:51 a.m.)		
	— 8:00 a.m. —	
	— 9:00 a.m. —	
		NWR #6, District FMO, and Forest FMO arrived at the fire (9:04 a.m.)
		NWR #6 Crew Boss assumes IC (9:30 a.m.)
Fire status assessment completed (~9:45 a.m.)		
	— 10:00 a.m. —	
NWR #6 Crew Boss Trainee completes crew briefing (~10:30 a.m.)		Plan is to put in "pump show, line, and mop up the fire"

Event	Time/Date	Response Actions
Forest FMO orders another crew (10:40 a.m.)		
District FMO orders barricade to close the road		
Pumps and hoses set up (~11:00 a.m.)	— 11:00 a. m. —	NWR #6 crew began working the fire on west and east side of the river (~11:00 p.m.)
Entiat IHC go to bed down at campground (~11:00 a.m.)		
From 11:00 p.m. to 12:00 p.m. • Some hoses burst • Trouble keeping pumps running • Four pulaskis break		
Dispatch notifies IC that Helicopter 13N available at NCSB (11:52 a.m.)		
	— 12:00 p.m. —	NWR #6 tactics changed to digging line (~12:00 p.m.)
		IC requests launch of Helicopter 13N (12:08 p.m.)
IC checks on arrival of Helicopter 13N and orders "1 or 2 more crews"(12:30 p.m.)		
		Air Attack diverted from Libby South Fire to Thirtymile Fire (12:40 p.m.)
Dispatch unable to contact Entiat IHC (12:49 p.m.)		
	— 1:00 p.m. —	NWR #6 crewmember sent to wake Entiat IHC (~1:00 p.m.)
Two civilians drive past the fire and crew toward the Thirtymile campground (~1:00 a.m.)		
Air Attack arrives at fire (~1:11 p.m.)		Air Attack orders SEAT (1:15 p.m.)
IC repeats order for 2 additional crews (1:43 p.m.)		

Event	Time/Date	Response Actions
Approval to launch Helicopter 13N (2:00 p.m.)	— 2:00 p.m. —	Entiat IHC arrive at fire (~2:00 p.m.) Helicopter 13N departs from 8-Mile Camp to begin making water drops (2:38 p.m.)
Engines #701 and #704 drive past crews looking for spotting (~3:30 p.m.)	— 3:00 p.m. —	NWR #6 pulled back to lunch site on west side of river (3:00 p.m.)
First Butte Lookout reports the fire is forming its own thunderhead (4:03 p.m.)	— 4:00 p.m. —	NWR #6 Squad 1 called up the road to support Engine #701 (~4:00 p.m.) NWR #6 Squad 2 called up to support Engine #701 (~4:20 p.m.)
Fire burns across the road entrapping Squads 1 & 2 (4:34 p.m.)		NWR #6 Squad 3 arrives at Engine #704 and immediately retreats toward lunch site (~4:34 p.m.) NWR #6 Squads 1 & 2 load in van and drive 1 mile up the road toward a deployment site
2 civilian campers arrive from the Thirtymile Camp site (~5:10 p.m.)	— 5:00 p.m. —	
Column of fire reaches the deployment site (5:24 p.m.) Firestorm moves beyond the deployment site		Shelters deployed (5:24 p.m.): • 10 people on the road • 6 people on the rock slope 2 crewmembers on the rock slope leave their shelters - 1 to the river and 1 to the van
At least 2 injured and 4 unaccounted for (5:48 p.m.)		10 people on the road move to the river People move from the river to the sandbar (~5:50 p.m.)
	— 6:00 p.m. —	Entiat IHC, NWR #6 Crew Boss Trainee arrive and begin to administer first aid (~6:00 p.m.) NWR #6 crew and civilians given medical treatment and evacuated

Appendix: Fire Behavior

On July 10, 2001, the weather and fuel moisture conditions in the Chewuch River canyon reached levels that reflected conditions normally present at the peak of the fire season in early August. Winter and spring weather patterns had left fuels abnormally dry and susceptible to the initiation and development of extreme fire behavior. The extreme fire behavior of the Thirtymile Fire could be expected under weather and fuel conditions present on July 10th; however it is unusual for this type of fire behavior to occur in this location in early July.

Information Available to Thirtymile Firefighting Personnel

The Fire Weather Forecast, issued 8:30 a.m. July 10th was not transmitted to the Thirtymile Fire. The Spot Weather Report for the Libby South Fire, issued 7:36 p.m. July 9th was the only Forecast delivered to firefighters on the Thirtymile Fire (See Appendix: Weather). This forecast predicted a minimum humidity of 10%, maximum temperatures of 98° F and winds from the south 9-13 miles per hour with gusts to 17 in the afternoon.

Fire Behavior Figure 1. Fireline Handbook Table 13 and the Relation to the Phases of the Thirtymile Fire Phases

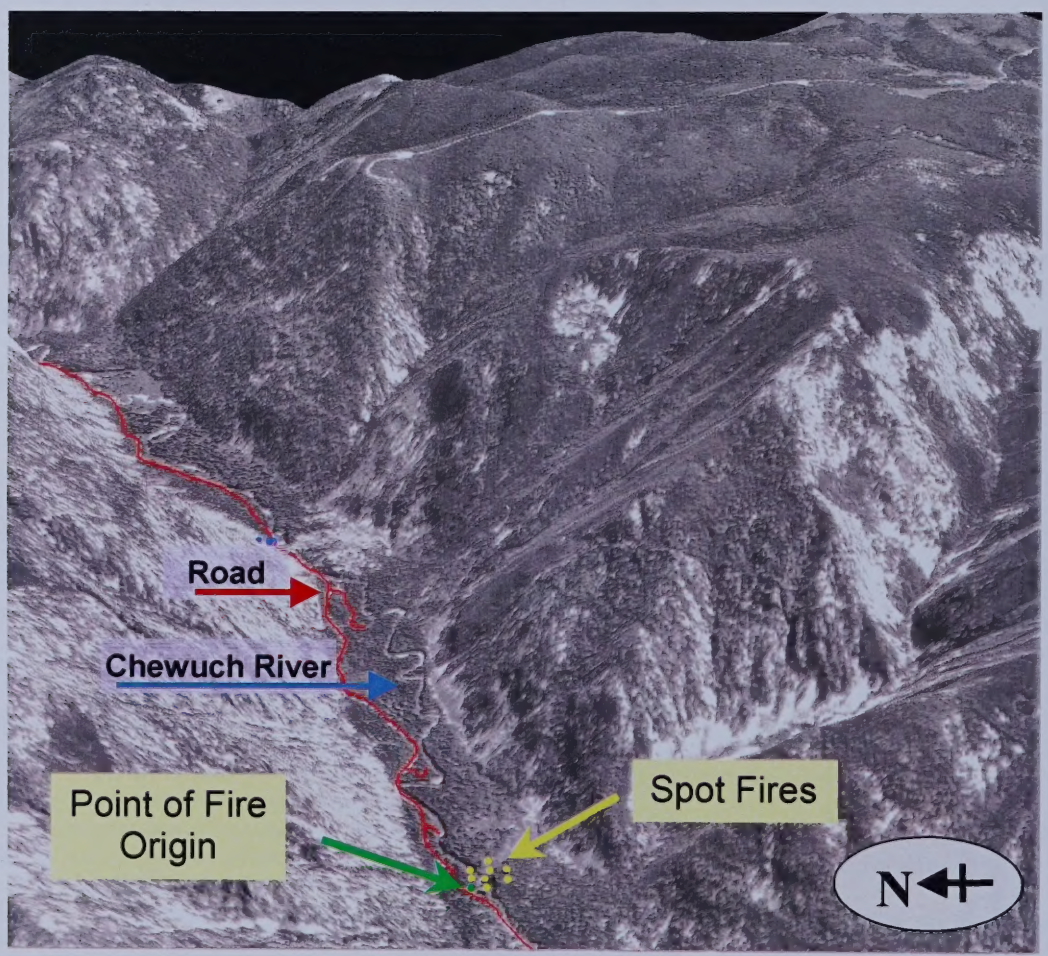
	Relative Humidity	Fuel Moisture 1-Hour	Fuel Moisture 10-hour	Relative ease of chance ignition and spotting, general burning conditions
	>60	>20	>15	Very little ignition; some spotting may occur with winds above 9mi/h.
Initial Phase	45 - 60	15-19	12-15	Low ignition hazard - campfires become dangerous; glowing bands cause ignition when relative humidity is < 50%
Initial Phase	30 -45	11 -14	10-12	Medium ignition hazard - matches become dangerous; "easy" burning conditions.
Initial Phase	26-40	8 -10	8-9	High ignition hazard; matches are dangerous; occasional crowning; spotting caused by gusty winds; "moderate" burning conditions.
Transition, Entrapment, and Deployment Phases	15-30	5-7	5-7	Quick ignition, rapid buildup, extensive crowning; any increase in winds causes an increased spotting, crowning, loss of control; fire moves up bark of trees igniting aerial fuels; long distance spotting in pine stands; dangerous burning conditions.
Transition, Entrapment, and Deployment Phases	< 15	< 5	< 5	All sources of ignition dangerous; aggressive burning, spot fires occur often and spread rapidly; extreme fire behavior probable; critical burning conditions.

Table 13 in the Fireline Handbook (NWCG Handbook 3 January 1998) displays the expected

Fire Severity for combinations of fuel moisture and relative humidity. While more sophisticated models of fire behavior exist, Table 13 would be the most readily available method to predict fire behavior by personnel on the Thirtymile Fire. Fire conditions that could have been expected for the Thirtymile Fire are noted on the left side of the Fire Behavior Figure 1 on the previous page.

Initial Phase (from late evening July 9 to 10 a.m. July 10)

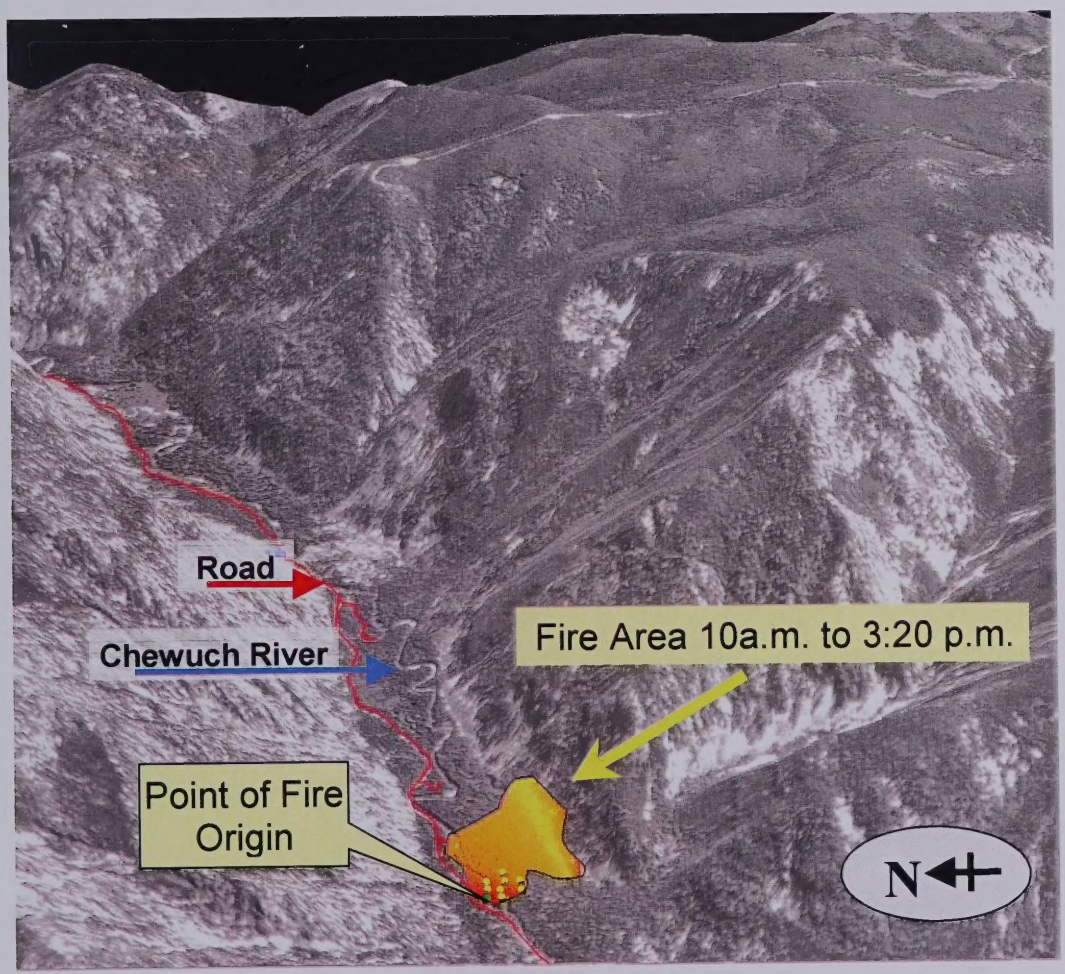
Following ignition, the fire remained active throughout the evening of July 9th and into the early morning of July 10th due to the presence of dry large diameter fuels and poor nighttime relative humidity recovery. Fire behavior at this time was characterized as slow surface spread (calculated rate 1.3 chains per hour). Although predicted flame lengths would be primarily less than 2.3 feet, the presence of downfall and ladder fuels promoted the extension of the fire into tree crowns initiating torching and spotting. At least 6 spot fires on both sides of the river resulted from these conditions.



Fire Behavior Figure 2. Initial Phase of the Thirtymile Fire

Transition Phase (from 10 a.m. to 3:20 p.m. July 10)

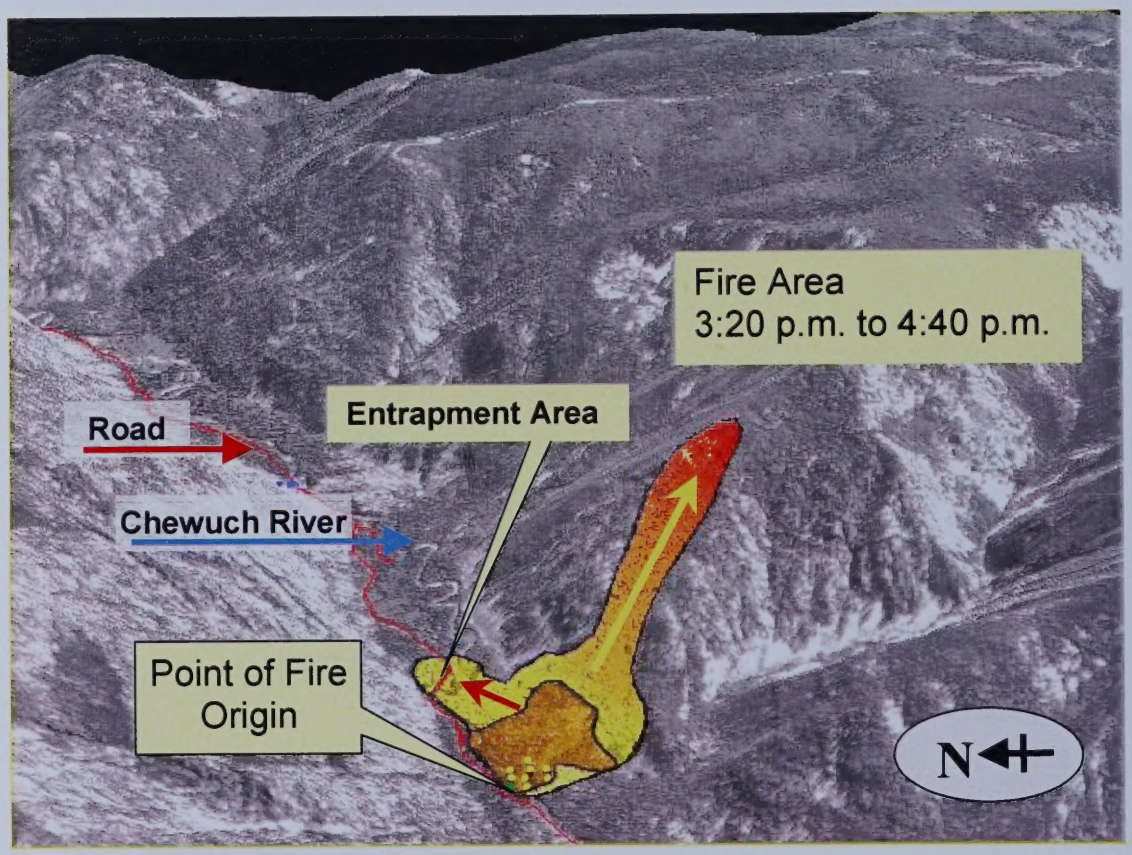
During the transition phase from mid-morning until mid-afternoon on July 10, the relative humidity rapidly decreases to less than 10% and temperature increases to 94° F. Surface fires became more active, with flame lengths approaching 8 feet, increasing the frequency of torching and spotting across containment lines. The fire began to gain a foothold on the east hillside of the canyon, but by 2:50 p.m. it had not yet begun a significant uphill run on this slope. At 3:00 p.m., because of increasing fire activity and spotting, firefighters moved to their identified "safety zone" on the west side of the Chewuch River. The rate of spread of the unconstrained surface fire at this time was calculated to be 10.8 chains/hour.



Fire Behavior Figure 3. Thirtymile Fire Spread 10 a.m. to 3:20 p.m. July 10th

Entrapment Phase (from 3:20 p.m. to 5:00 p.m. July 10th)

At 3:20 p.m. the fire began uphill crowning runs from base of east slope. Slopes of nearly 100%, dense forests, and upslope convective winds combine to move this fire uphill at approximately 1.25 miles per hour (100 chains per hour). Spotting was pervasive from all active portions of the fire both in the canyon floor, and up the east slope. The fire established a convection column on the hillside east of the canyon floor. Spot fires became established east of the road 0.4 miles



Fire Behavior Figure 4. Thirtymile Fire Spread 3 p.m. to 4:40 p.m. July 10th

from the main fire area.

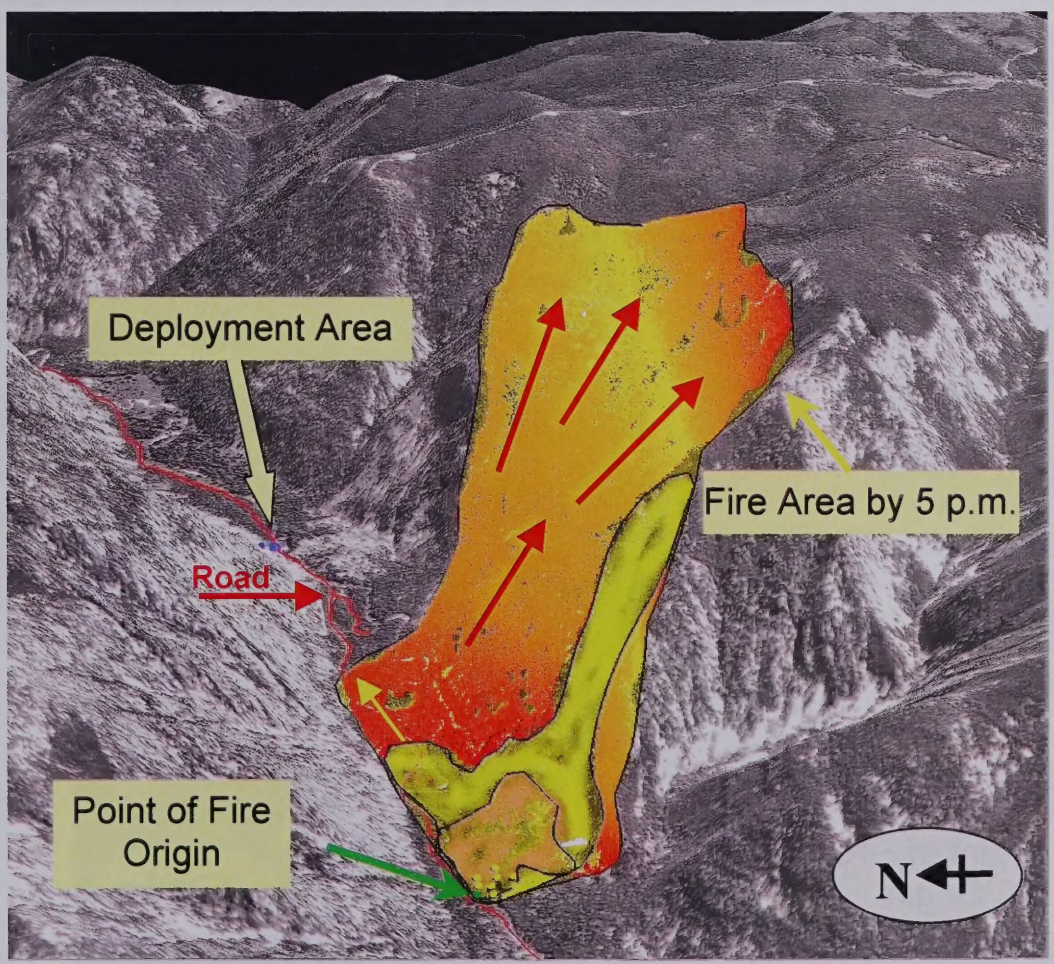
Within an hour the fire in the canyon floor began a sustained torching run in tree crowns and at 4:34 p.m. crossed the road at the entrapment point. The up canyon spread of the fire up to this point had been parallel to the road. With a 90-degree turn in the road to the SE, the orientation of fire spread was now directly perpendicular to the road.

A variety of sites and fuel types describe conditions within the Chewuch River canyon. This difference is significant, insofar as it may have influenced tactical decisions as the fire moved between fuel types through July 10. At the point of origin, where the fire was first attacked, spruce and alder dominate the site within a riparian zone. Aspen is also nearby. This is a wetter site relative to the drier surrounding areas where fir, lodgepole, and ponderosa pine occur and

where the fire made its largest runs on the afternoon of July 10th.

Contrasting patterns of fire behavior were observed between the wetter fuel types in the riparian zones and the drier upland fuel types. Initially, the fire spread was principally influenced through torching and spotting in the wetter types, while sustained crowning better defined fire spread in the drier types. The differing patterns of fire behavior were influenced both by the nature of the fuel types, and increasingly drier and warmer conditions encountered as the day progressed. It is remarkable that after the fire, although there are isolated patches of fire-scorched and fire-killed trees in the vicinity of the point of origin, much of the area within the riparian zone where the fire was first attacked remains unburned.

When the fire spread out of the riparian zone, as weather conditions worsened, fire intensities and rates of spread increased considerably. The fuels type and drier conditions were more conducive to rapid spread rates and more severe fire behavior. Notably, entrapment occurred in



Fire Behavior Figure 5. Thirtymile Fire Spread by 5:00 p.m. July 10th

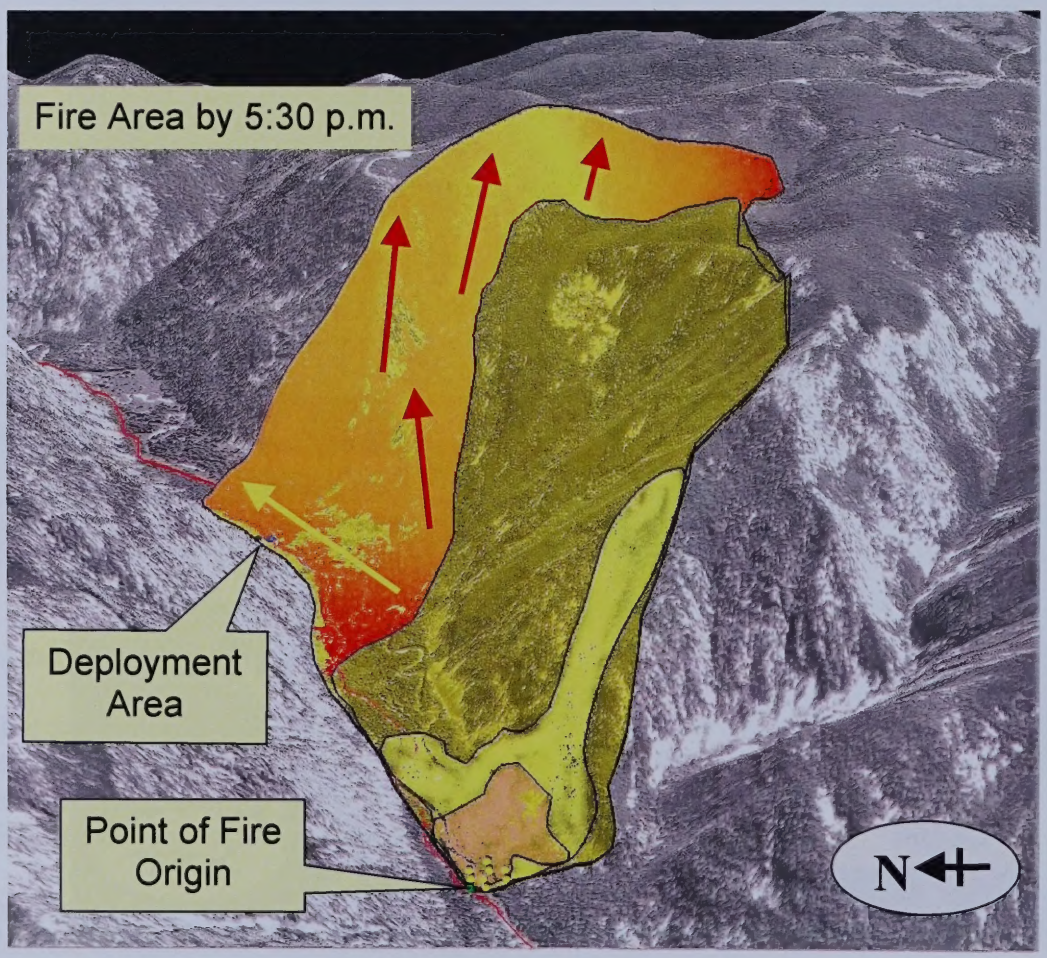
the drier fuels at a bend in the road (perpendicular to the direction of spread), where the only path of down-canyon escape was blocked by the head of the fire moving up-canyon.

This was a result of the tactical decision to suppress spot fires ahead of the main fire along the road, which placed firefighters under increasingly severe weather conditions in a different fuel type that exhibited different, more severe, fire behavior.

By 5:00 p.m. the fire had become well-established on the canyon floor east and west of the Chewuch River and on the canyon slope east of the river.

Deployment Phase (from 5:00 p.m. to 8:00 p.m. July 10th)

At about 5:00 p.m., the fire was firmly established on the hillside east of the Chewuch River. Strong uphill and up canyon fire movement had carried the fire in an easterly direction and crown fire activity was engulfing the hillside east of the deployment location. An active fire front was also located in the canyon bottom in the vicinity of the point of entrapment along a line



Fire Behavior Figure 6. Thirtymile Fire Spread by 5:30 p.m. July 10th

extending from the base of the northern hillside to the hillside south of the fire.

Strong indrafts and massive spotting associated with the crown fire high on the hillside east of the river intensified the fire activity in the canyon floor. At approximately 5:00 p.m., the fire in the canyon floor transitioned to an active crown fire moving up canyon towards the deployment zone at spread rates estimated to be in excess of 1.6 miles per hour (125 chains per hour).

Two columns had now formed, one on the hillside east of the river and a second column located on the canyon floor. The canyon floor column was initially oriented horizontally directly towards the deployment zone. While the exact interaction of the columns is unknown, it is felt that the column on the hillside south of the river established strong up canyon winds which contributed to the speed and intensity of the canyon floor fire front as it moved up canyon. Immediately preceding fire shelter deployment., embers falling from the fire columns rained down on the deployment site. The flaming front and plume of hot gasses from the canyon floor fire reached the deployment site at 5:24 p.m. The canyon floor fire continued to intensify as it moved past the deployment site to the east and its column began to rise vertically. The column in the canyon floor and the column on the hillside east of the river eventually merged as the fire moved up canyon. The rate of fire movement and intensity of fire activity is characteristic of crown fires observed historically.

During this period of time the fire also began to extend up the northern hillside north of the creek. The scarcity of fuels on this hillside limited the fire behavior, which consisted initially of spotting and isolated torching. Fire behavior became more severe as the forest became denser on top of the ridgeline and north of the deployment site.

Fire continued up canyon at 1.6 miles per hour (125 chains per hour) reaching the trailhead within approximately 1 hour.

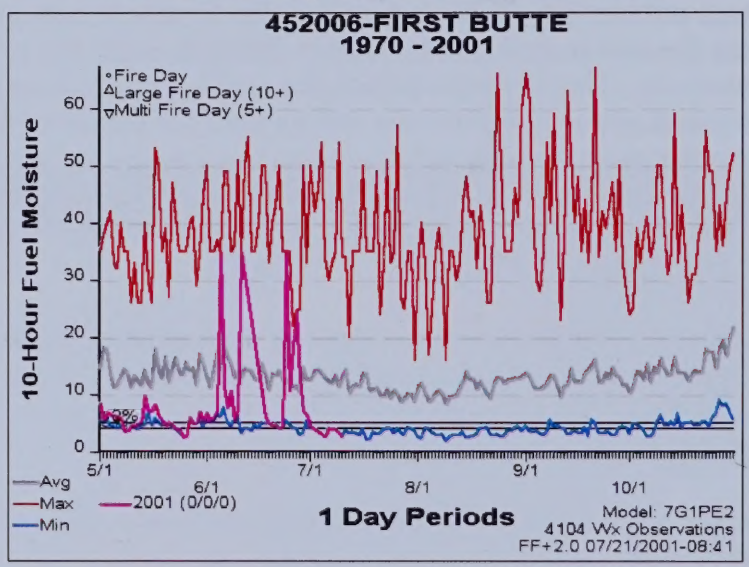
Factors Contributing to Fire Behavior on the Thirtymile Incident

Fuel Moistures

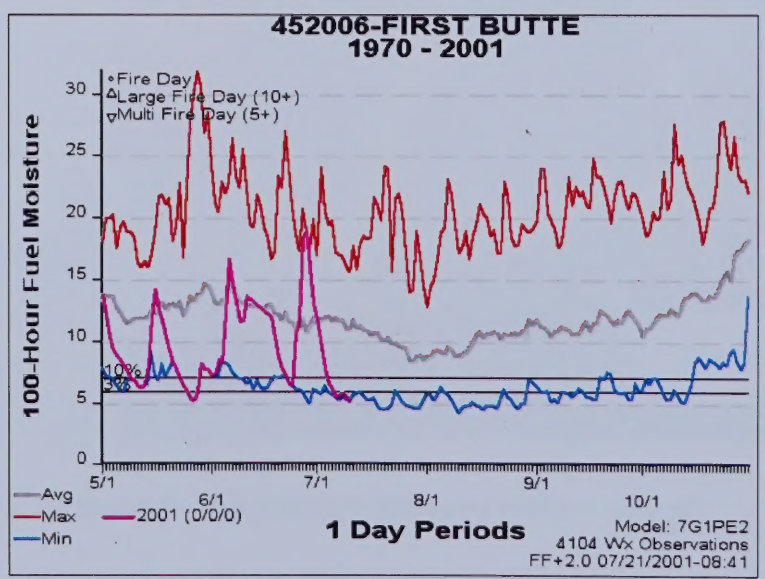
All calculated fuel moistures were at or approaching historically low levels for July 10th. The 10-hour and 100-hour fuel moistures were at 3% and 5% respectively.

Calculated 1000-hour fuel moisture was at 10%. 1000-hour fuel moistures had been persistently

Fire Behavior Figure 7. 10-Hour Fuel Moisture

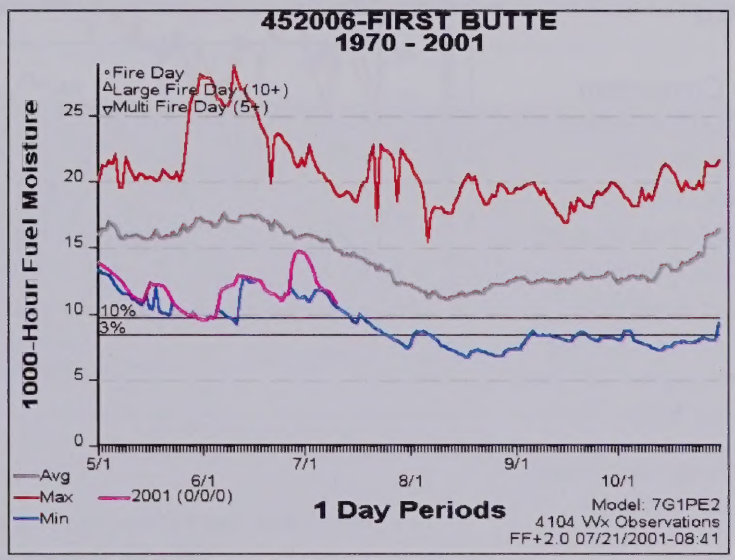


Fire Behavior Figure 8. 100-Hour Fuel Moisture



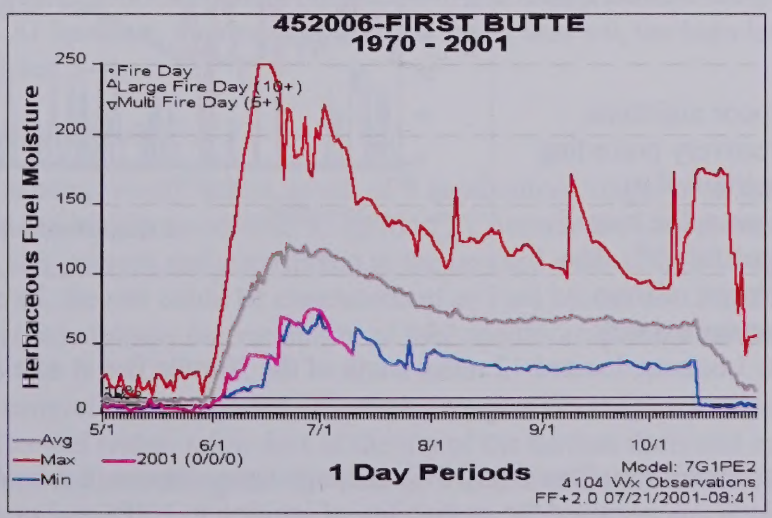
low since the end of April. The fact that the large diameter fuels were extremely dry is evidenced by nearly complete consumption of these fuels in many locations on the Thirtymile Fire.

Fire Behavior Figure 9. 1000-Hour Fuel Moisture



Live fuel moistures were calculated at 48%. Although the measurement of live fuel moisture is extremely difficult observations taken from in the vicinity indicate values of less than 100%, which are drier than normal for this time of the year. Foliar moisture content of conifer needles of less than 100% increased the likelihood of surface fire extending into the tree crowns and initiating torching.

Fire Behavior Figure 10. Herbaceous Fuel Moisture

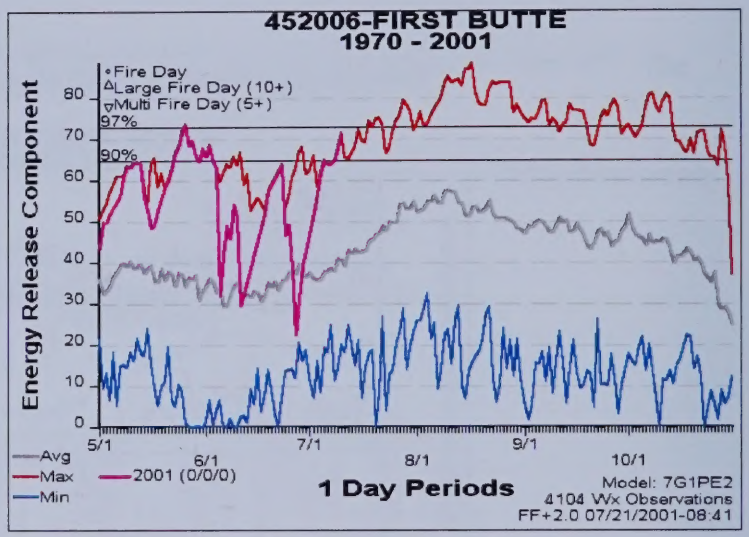


Fire Behavior Indices

The two closest National Fire Danger Rating System Fire Weather Stations, First Butte (elevation 5,509 feet) and NCSB (elevation 1,697 feet), classified the fire danger as "*Very High*" on July 10, 2001.

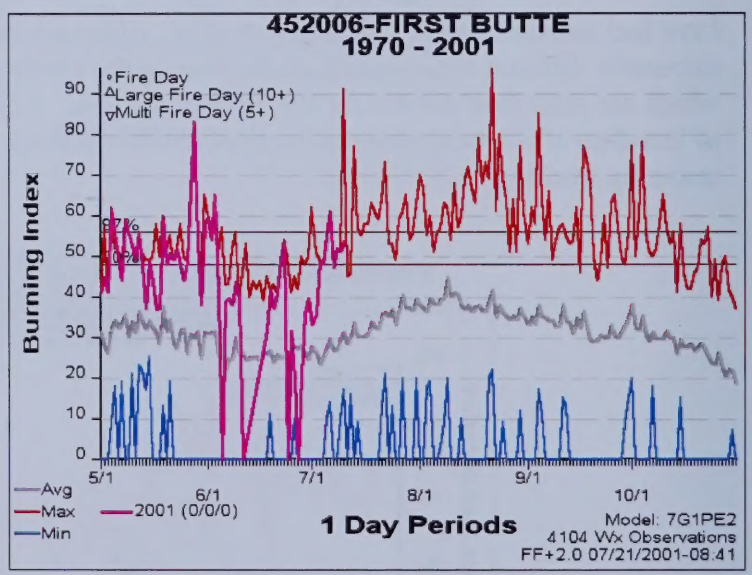
The Energy Release Component (ERC) for First Butte (Fuel model G) is 71 and was close to the 97th percentile (71.75), the historical maximum for that day since records began in 1970. The ERC index describes the potential available energy per unit area in the flaming zone of the fire. Since April 14th the ERC at this station had been consistently approaching maximum levels except for 3 time periods following rainfall.

Fire Behavior Figure 11. Energy Release Component



The Burning Index for First Butte (Fuel model G) was at 52 and approaching the 97th percentile. The Burning Index reflects the contribution that fire behavior makes to the amount of effort needed to contain a fire in a specified fuel type.

Fire Behavior Figure 12. The Burning Index



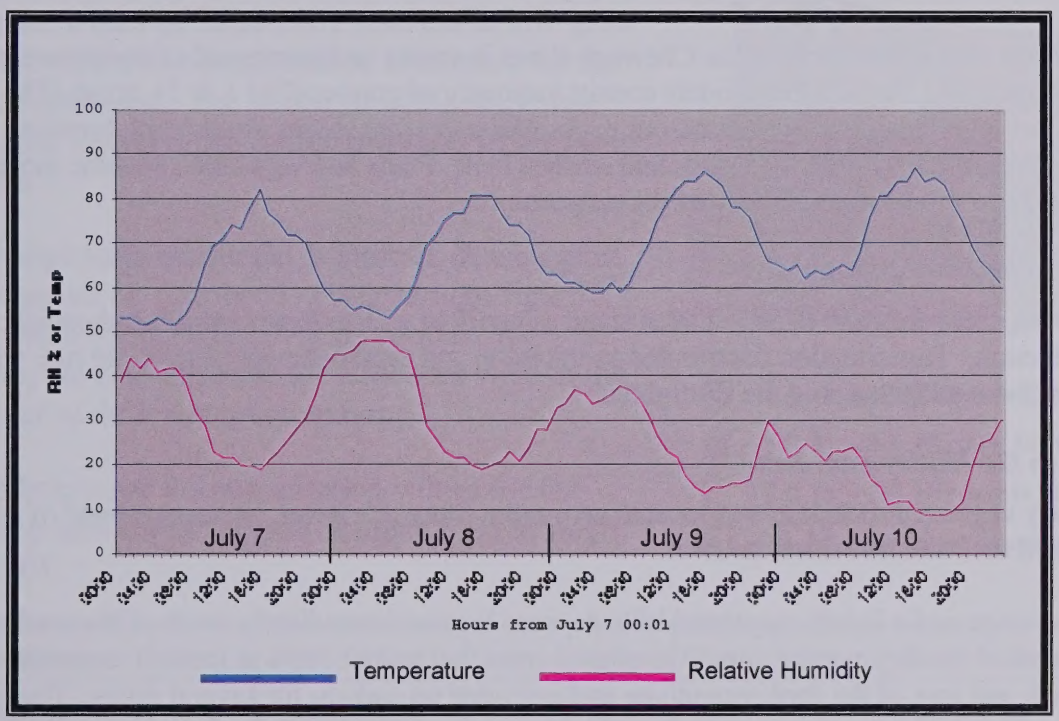
Weather

A 5-day period of poor nighttime relative humidity recovery preceding the deployment contributed to spotting and subsequent fire spread during the evening of July 9th. The chart in Figure 6 depicts relative humidity and temperature trends from the First Butte Lookout, located 12 miles south of the 30-mile fire at an elevation of 5,509 feet.

Critically low relative humidity (less than 10%) and high temperatures (daytime maximum of 94) on the day of deployment raised the probability of ignition to 100% and increased the potential for extreme fire behavior.

Fire induced winds became significant. The helicopter pilot on west side of the fire observed in drafts of 20 to 30 mph associated with fire activity at this time. Entrapped firefighters remarked

Fire Behavior Figure 13. First Butte Lookout
Temperature and Relative Humidity Observations July 7 - July 10, 2001



on high winds and the difficulty of keeping fire shelters in place.

On July 10 atmospheric conditions were conducive to the formation and vertical development of the fire columns. At Spokane, the mid-level Haines Index was a 6, the high level Haines index reached a 4 (predicted 3-4).

Fuels on the Canyon Floor

Abundant large diameter woody debris, much of it in advanced stages of decomposition, was present on the site and highly susceptible to ignition by firebrands. Extensive shrub and conifer reproduction was also present and contributed to the upward extension of surface fire into the tree crowns. Overall, the site could be characterized as Fuel Model 10. Fuel Models 8, 10, and 12 would, however, encompass the variability of fuel conditions present on the canyon floor site.

The forest on the canyon floor consisted of spruce, Douglas fir, lodgepole pine, and cottonwood. Spruce boughs extended within a few feet of the top of the surface fuels and increase the likelihood of surface fire extending into the tree crowns and initiating torching.

Fuels on the Hill Slopes

Forest vegetation was predominantly Douglas fir and lodgepole pine. Timbered areas were densely stocked, with branches extending downward within a few feet of the top of the surface fuels. Fuel Models 8 and 10 would encompass the variable fuel conditions present on this slope.

Vegetation on hillside north of the Chewuch River is sparse and composed of ponderosa pine and Douglas fir. Surface fuel models consist variously of grasses (FM 1 & 2), brush (FM 5 and 6), and woody fuels (FM 10). Numerous rockslides and scree slopes are present, breaking up the horizontal continuity of forest stands and surface fuels. Fuels and vegetation become more continuous near and along the top of the ridgeline.

Fuels in the Entrapment Area

The entrapment area had tightly spaced stand of conifers with extensive shrub and conifer reproduction. This situation contributed to initiation and establishment of torching run, which crossed the road entrapping the firefighters.

Fuels in the Deployment Zone

A lightly vegetated rockslide was located across the Chewuch River. A narrow band of conifers separated the rockslide from the river.

A scree slope and a lightly vegetated hillside were located immediately north of the road to the northwest of the deployment site. A timbered area (fuel model 10) was located immediately to the north and east of the deployment site and extended up canyon for several miles. The general nature of the deployment zone contributed to the survivability by 12 firefighters and 2 civilians. The scarcity of fuels on the hillside above the deployment site and on the non-forested rockslide to the south across the river limited the amount and duration of heat at the deployment site on the road. The narrow band of conifers on the south side of the river may have partially shielded firefighters on the road from the initial blast of heat from the fire.

The fuels in the immediate vicinity of the fatal deployment zone consisted of duff, litter, and rotten wood lying among the boulders and rocks of the scree slope. This material presumably was deposited there from the trees that grew next to this area. Other areas on the rockslide farther away from the trees and fatalities contained less of this duff and litter, although isolated large rotten logs were present, as evidenced by the burn patterns on the rockslide. A timbered area (fuel model 10) was located within 20 feet to the east of this site.

Topography

Topography of the canyon bottom was essentially level enabling initial dispersion of fire in several directions. The fire was positioned at the base of a steep (70% +) slope that enables the rapid, high intensity uphill movement of the fire south of the river. The orientation and narrowness of the river canyon tended to channel and focus up the canyon the diurnal and fire induced winds.

Appendix: Weather

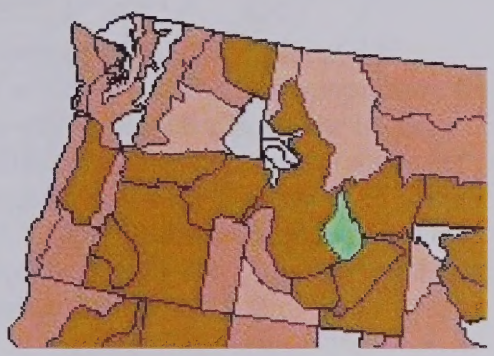
Prior Conditions

Persistent high pressure over the eastern Pacific during the winter of 2000-2001 resulted in low snow pack and record low precipitation amounts over the Pacific Northwest. The winter of 2000-2001 was the second lowest precipitation producer in the past 30 years.

The precipitation amount at Winthrop, Washington, for the period of October 1, 2000 through June 30, 2001, was 6.87 inches or 57% of normal. In addition, the east slopes of the Cascades were in the third year of deficient precipitation.

Shown below are the precipitation values for the Winthrop area for the period October 2000 through June 2001.

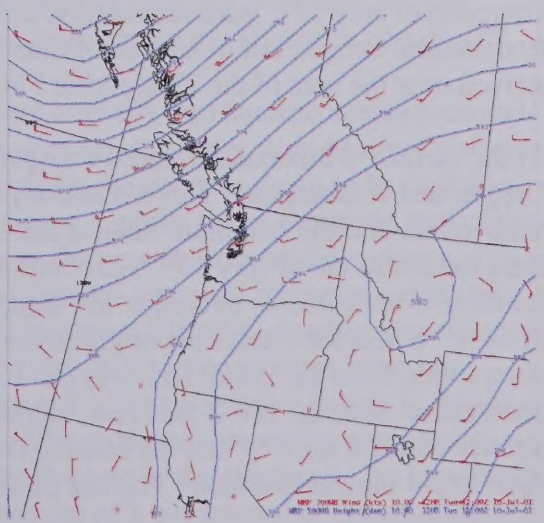
Palmer Drought Index issued 7/14/01



-4.0 or less (Extreme Drought)
-3.0 to -3.9 (Severe Drought)
-2.0 to -2.9 (Moderate Drought
-1.9 to +1.9 (Near Normal)

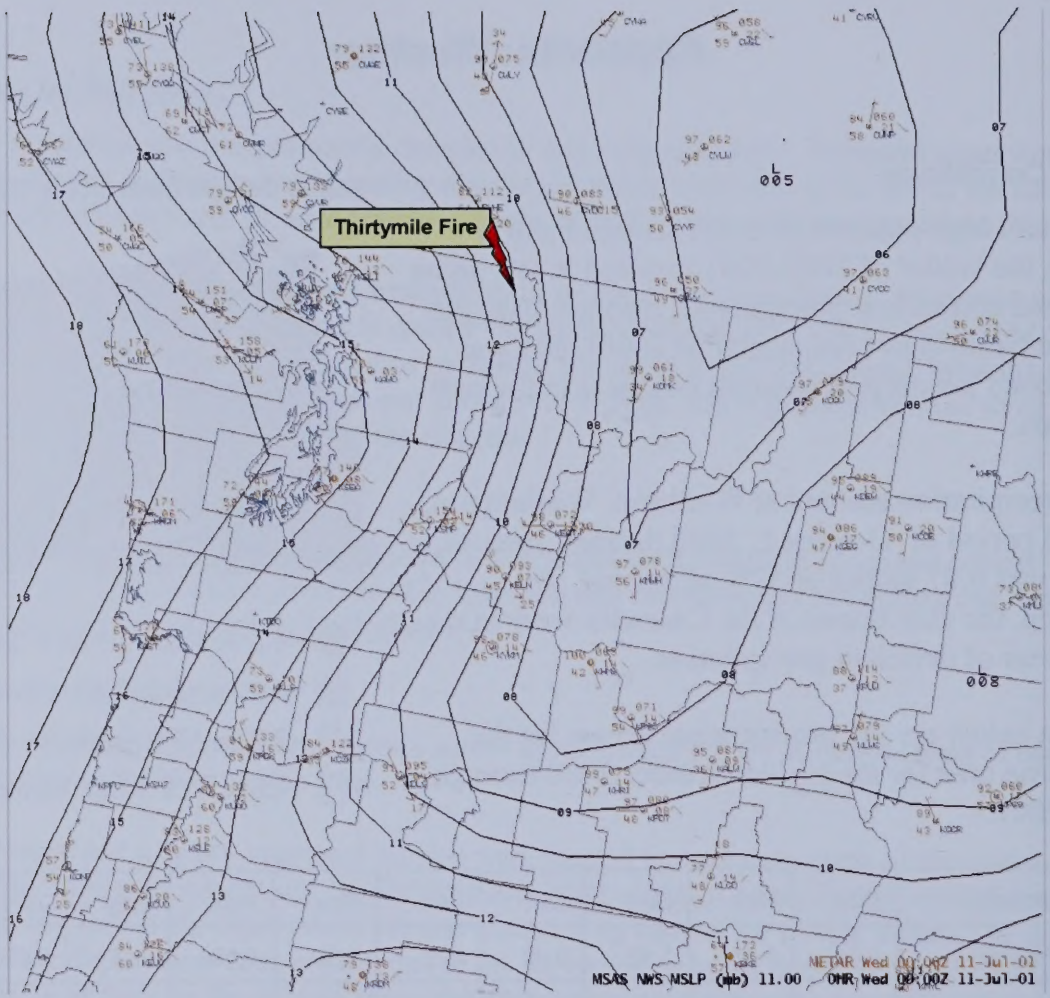
Inches	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Actual	1.04	1.18	1.12	0.49	0.71	1.02	0.39	0.12	0.80
Normal	0.83	1.86	2.44	1.99	1.40	0.89	0.72	0.96	1.01
Departure	0.21	-0.68	-1.32	-1.50	-0.69	0.13	-0.33	-0.84	-0.21

Afternoon temperatures at First Butte RAWS ranged from 73° to 87°F with minimum humidities from 9 to 20% the 5 days prior to the fire. The North Cascades Smokejumper Base was near 100° F with a minimum relative humidity of 9% the afternoon of July 9th. (See Weather: Attachment 1)



Tuesday July 10, 2001

On July 10th, a persistent upper level trough remained over the off shore waters of the Pacific Northwest, while an upper level ridge continued over the south central United states. These features were producing south to southwest flow of air aloft over the Pacific Northwest. Embedded in this



southwest flow were weak disturbances moving northward from off the southern California coast and out of the desert southwest. These weak weather systems were responsible for the scattered thunderstorms that occurred as far north as central Oregon the afternoon of July 9th. During the afternoon of July 10th, infra-red satellite imagery showed that one disturbance, moving north from central Oregon out of an area of thunderstorm debris from the previous afternoon, had arrived over the area of the Thirty Mile Fire.

At the surface, a thermally induced trough of low pressure had pushed northward into eastern Oregon and Washington. This hot and dry air mass was responsible for the 101° F high temperature and the minimum relative humidity of 4% at the North Cascades Smoke Jumper Base the afternoon of July 10th. Early morning observations from the fire site reported by the Entiat IHC indicated an overnight low temperature of 61° F and a maximum humidity recovery of 54%. Winds were calm overnight in the Chewuch River canyon floor. The 8:30 a.m. (PDT) observation from the Entiat IHC was 68° F, relative humidity 48%, and calm wind. The first observation from the NWR #6 Crew, taken at 12:20 p.m. (PDT) showed that the temperature had already climbed to 91° F and the relative humidity had dropped to 10%. The wind speeds had risen to 2-4 mph at that time. The last observation recorded by the NWR #6 crew was taken at

2:00 p.m. (PDT) with a temperature of 94°F, relative humidity 8%, and a wind speed of 2 mph. As the fire developed and smoke began to obscure the sun, later observations again taken by the Entiat IHC showed temperatures ranging from 86° to 90°F, with relative humidity 12 to 19%, and wind speeds from calm to 2-4 mph. (See Weather: Attachment 2)

The radiosonde upper air sounding from Spokane for the morning of July 10th indicated a surfaced based inversion extending to near 5000 feet mean sea level (MSL). The temperature for the atmosphere to become unstable and support convection was 95°F with a top to the lift near 40,000 feet MSL. To the north, at Kelowna, British Columbia, the convective temperature was 100°F with a top also near 40,000 feet MSL. Afternoon temperatures were forecast to be in the upper 80s to mid 90s (88°- 95°F) in Fire Weather Zone 685. Haines Indices generated from the Spokane morning sounding on July 10th indicated a mid-level value of 6 and a high level value of a 3 and 4. A mid level Haines Index of a 6 is very common for the months of July and August in eastern Washington. (See Attachment 3)

The Haines Index was devised by Donald Haines in the late 1980s as a national index for large fire growth based on the stability and moisture content of the lower atmosphere. The actual Haines Index is derived from twice-daily upper air soundings taken over the continental United States and Canada. Indices range from a 2, which indicates moist and stable air, to a 6, indicating dry and unstable air. Elevations range from a Low Level, approximately 2,000 to 5,000 feet above MSL, to a High Level at approximately 10,000 to 18,000 feet MSL. In resent years, computer models have been developed to generate forecast Haines Index values from several available weather computer models.

While winds along the Chewuch River canyon bottom remained light, ridge top 20 foot, 10 minute average winds at First Butte weather station (RAWS) were steady at 5 to 7 mph from the southwest to west with occasional winds from the south and northwest. Gusts reported by the RAWS site of 14 to 20 mph are 1 second instantaneous winds and not considered a true wind gust. Comparable 1 minute winds would be in the 9 to 11 mph range with possible gusts of 15 to 17 mph as derived from Wind Conversion Charts. These wind speeds correspond to those observed manually by lookouts at First Butte and Goat Peak during the afternoon of July 10th.

As the afternoon of July 10th progressed, the atmosphere over the area became unstable enough to support large column development. The morning upper air soundings from nearby Spokane, Washington, and Kelowna, British Columbia, indicated that the day was going to be unstable. During the afternoon, fair weather cumulus developed over the hills to the south and east of the fire and over the plains of southeast British Columbia as shown on visual satellite photos. The same time the smoke column from the Thirtymile Fire showed a marked increase in size and enhanced development, the fair weather cumulus over southeast British Columbia also enhanced. (See Figure 1 - Visual Satellite Image 11/0030z or 10/1730 PDT). Ten minutes later, two distinct plumes became evident from the fire. (See Figure 2 - Visual Satellite Image 11/0040Z or 10/1740 PDT). From individual testimony and video of the column it should be noted that two distinct counter-rotating columns were observed on the fire late in the afternoon. As previously mentioned, infra-red satellite images showed the movement of a weak weather disturbance northward from central Oregon to over the Thirty Mile fire during the afternoon of the July 10th.

This is evident from the observed northward movement of the debris clouds from the previous day's convection over central Oregon. Wind speeds over the fire site between 20,000 and 30,000 feet MSL increased by 20 to 30 knots as verified by the 11/00Z and 11/12Z sounding from Kelowna, British Columbia. The coincidental arrival of the weak weather disturbance from Oregon and the significant increase in the afternoon and evening wind speeds near the top of the column contributed to the already unstable air mass and possibly aided the fire's column development.(See Weather: Attachments 4 and 5.)

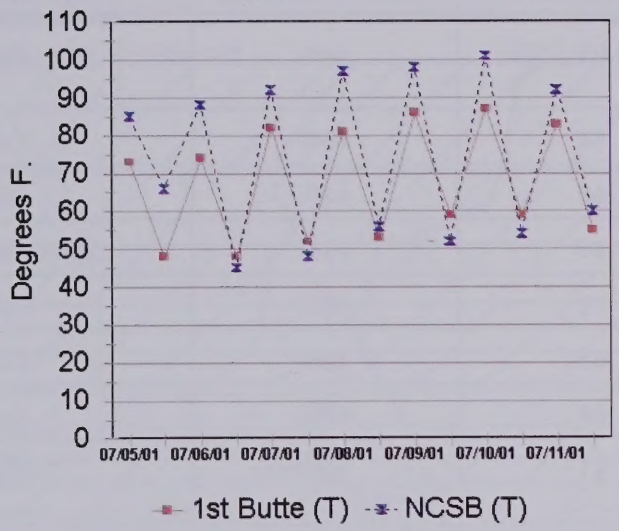
Summary

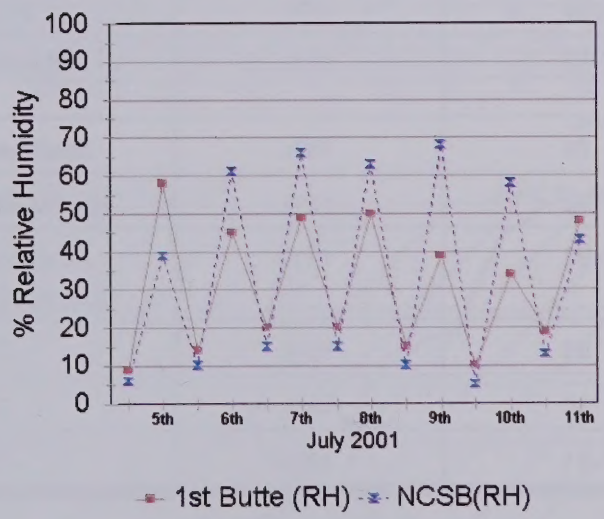
The combination of near record low snow pack and lack of precipitation during the winter of 2000/2001 contributed significantly to the very dry fuel conditions present this year in the Chewuch River. By the 10th of July, near record temperatures, the long, dry days, an unstable atmosphere and a receptive fuel bed all combined to produce a plume dominated fire.

Photo by Sandor A. Feher, Winthrop, WA

The Thirty Mile Fire in the late afternoon (~ 5:30 p.m. PDT), July 10, 2001

Weather Appendix Attachment 1.
RAWS Observations for First Butte and NCSB Sites





NOTE:

- NCSB is a Remote Automatic Weather Station at the North Cascade's Smoke Jumper Base, to the east of the town of Winthrop, WA.

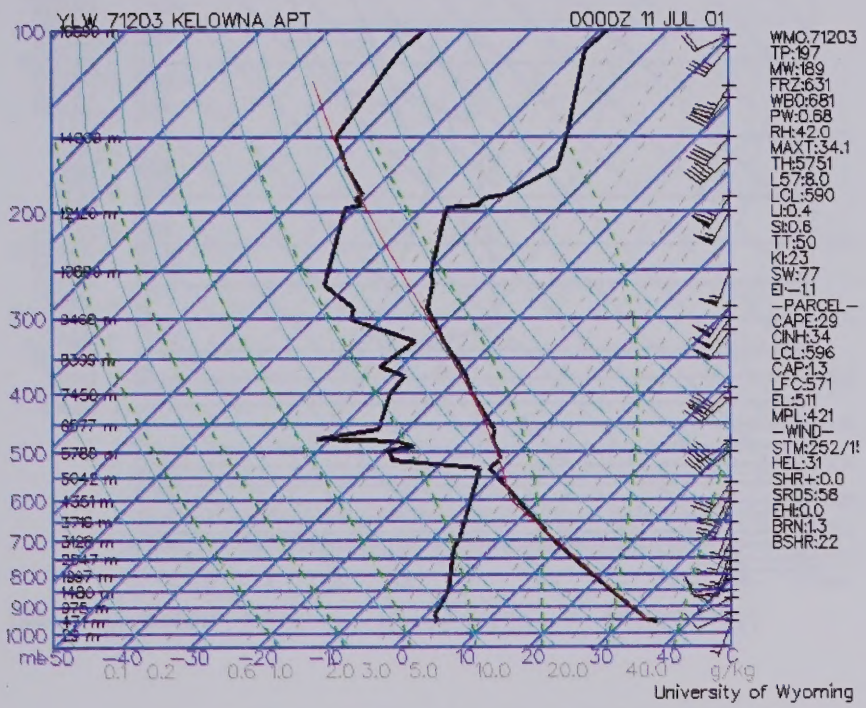
- 1st Butte is a Remote Automated Weather Station near the 1st Butte Lookout to the southeast of the Fire Site.

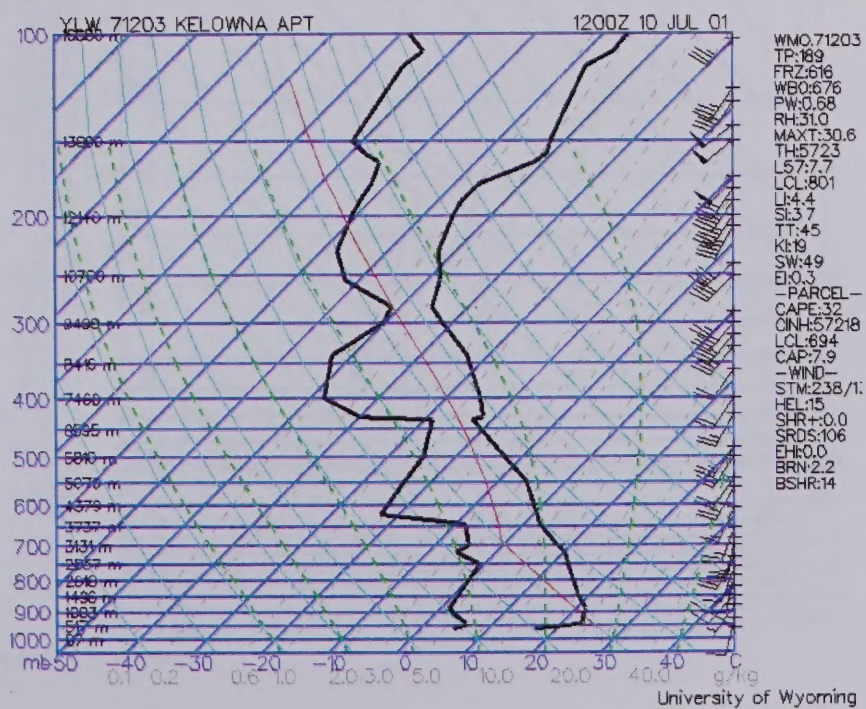
Weather Appendix Attachment 2. Observations taken by the Entiat IHC and the NWR #6 Crews

Time	Temperature	Relative Humidity	Eye Level Wind
Entiat IHC 10/0130	61	54%	Calm
10/0230	66	49%	Calm
10/0330	65	44%	Calm
10/0430	63	43%	Light Down Canyon
10/0630	62	48%	Calm
10/0730	65	42%	Calm
10/0830	68	48%	Calm
NWR#6 10/1220	91	10%	2-4G8 mph
10/1250	89	9%	2G8 mph
10/1400	94	8%	2G5 mph
Entiat IHC 10/1445	87	17%	Winds Missing
10/1515	86	16%	Southwest 1-2 mph
10/1545	88	12%	Northwest 2-4G6 mph
10/1615	87	13%	Northwest 2-4 mph Gust to 17 mph in River
10/1645	89	15%	Calm
10/1715	90	13%	Calm
10/1900	81	19%	Calm

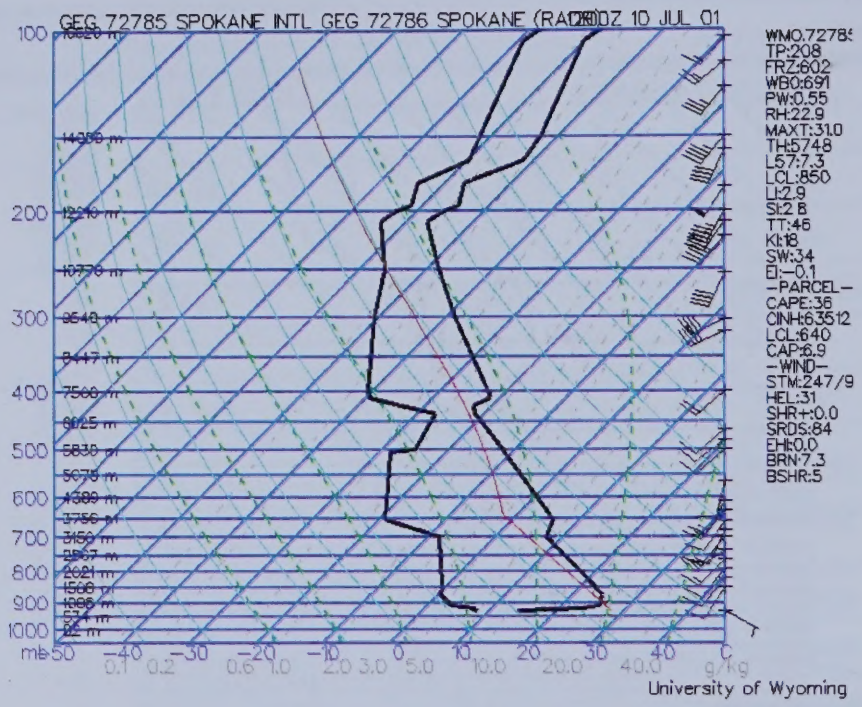
- G = Gust

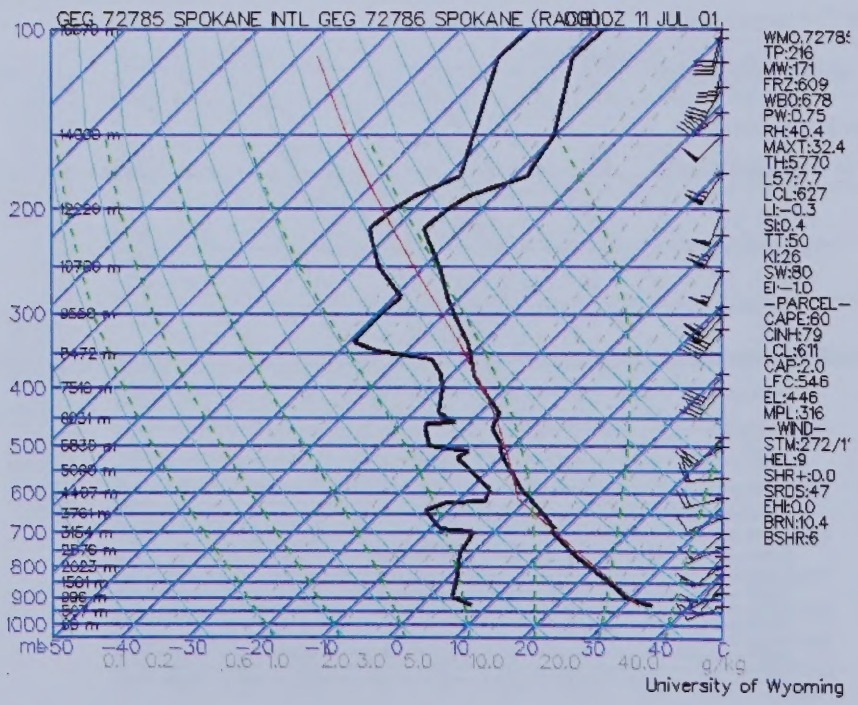
Weather Appendix Attachment 3
Kelowna B. C. and Spokane, WA Upper Air Soundings



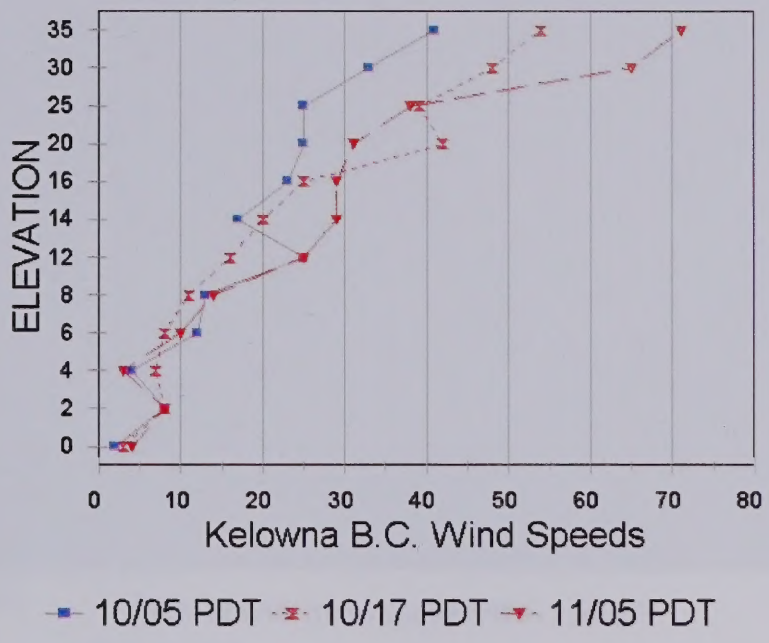


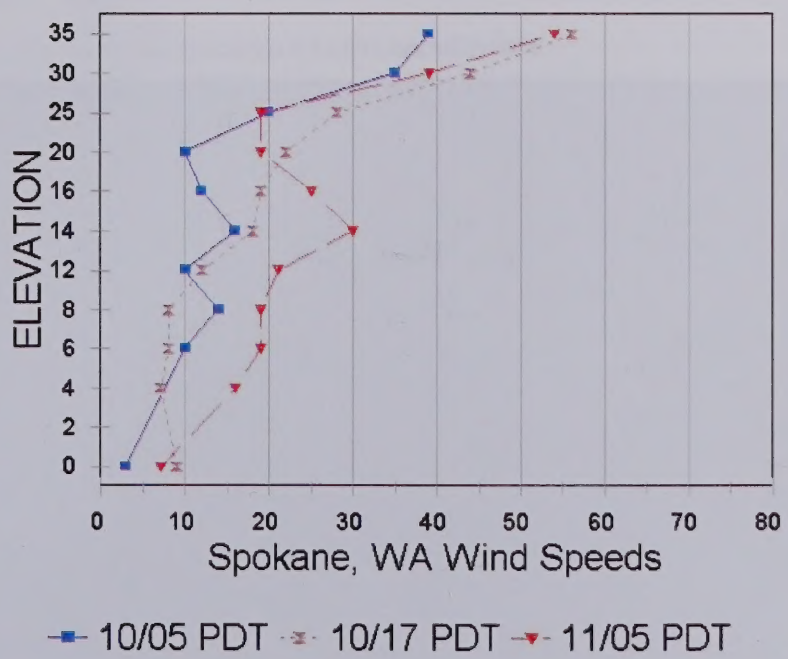
Weather Appendix Attachment 3 (continued)





Weather Appendix Attachment 4
Upper Level Wind Speed Plot Kelowna, British Columbia, and Spokane, WA





Weather Appendix Attachment 5
Visual Satellite Images

Figure 1 - 07/11/0030Z or 07/10/1730 PDT

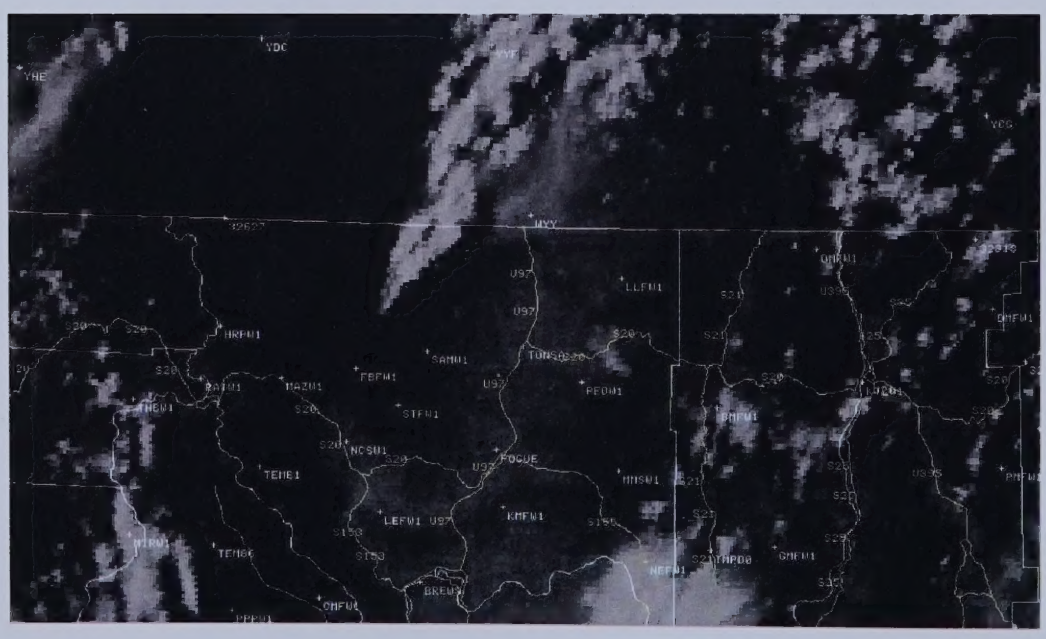


Figure 2 - 07/11/0040Z or 07/10/1740 PDT

Weather Appendix Attachment 6
Spot Forecast for Libby South Fire

SPOT FORECAST FOR LIBBY SOUTH FIRE.....DNR - NE
ISSUED BY NATIONAL WEATHER SERVICE SPOKANE
736 PM PDT MON JUL 9 2001

DISCUSSION...DRY WEATHER PATTERN WITH HOT AFTERNOON TEMPS AND LOW RELATIVE HUMIDITY WILL STAY PUT ACROSS THE BURN AREA THROUGH TUESDAY. EXPECT GUSTY AFTERNOON UPSLOPE-UPVALLEY WINDS FOLLOWED BY SOMEWHAT LIGHTER DOWNSLOPE-DOWNVALLEY WINDS AT NIGHT. POOR TO FAIR RELATIVE HUMIDITY RECOVERY CAN ALSO BE EXPECTED AT NIGHT.

FOR THIS EVENING

WEATHER.....PARTLY CLOUDY.
CWR.....0%
TEMPERATURE.....88-92
HUMIDITY.....4%
WIND...EYE LEVEL..SOUTH WIND 10 MPH GUSTS TO 17 MPH.

FOR OVERNIGHT

WEATHER.....MOSTLY CLEAR
CWR.....0%
TEMPERATURE.....MIN 57
HUMIDITY.....MAX 55%
WIND...EYE LEVEL..BECOMING NORTH 4-9 MPH AROUND 9PM.

OUTLOOK FOR TOMORROW

WEATHER.....PARTLY SUNNY.
CWR.....0%
TEMPERATURE.....MAX 98
HUMIDITY.....MIN 10%
WIND...EYE LEVEL..NORTH WIND 5-9 MPH BECOMING SOUTH 9-13 MPH BY AROUND10AM WITH GUSTS IN THE AFTERNOON TO 17 MPH.

Weather Appendix Attachment 7
Spokane Fire Weather Forecasts for Zone 685

FIRE WEATHER FORECAST
NATIONAL WEATHER SERVICE SPOKANE WA
830 AM PDT TUE JUL 10 2001

DISCUSSION...WILL BE ANOTHER HOT DAY TODAY WITH TEMPERATURE VERY SIMILAR TO YESTERDAY OR POSSIBLY A DEGREE OR TWO WARMER. CONTINUED DRY WITH MIN RELATIVE HUMIDITIES DOWN IN THE SINGLE DIGITS IN NUMEROUS LOCATIONS. MOISTURE OVER OREGON STILL WORKING ITS WAY NORTH AND THERE IS A QUESTION AS TO WHICH SIDE OF THE CASCADES IT WILL MOVE OVER. WILL KEEP A SLIGHT CHANCE IN THE SOUTHERN CASCADES FOR LATER THIS AFTERNOON. ANOTHER WAVE WILL MOVE NORTHEAST OVER EASTERN WASHINGTON AND THE IDAHO PANHANDLE TONIGHT AND WEDNESDAY MORNING. AGAIN ONLY SLIGHT CHANCES IN THE NORTHEAST AND NORTHERN IDAHO. THUNDERSTORMS AT THIS TIME LOOK WET AND SHOULD BE ACCOMPANIED WITH SOME GUSTY WINDS.

****
WIND FORECASTS ARE FOR 20 FOOT WIND SPEEDS (VALLEYS AND RIDGE TOPS) AND ARE 10 MINUTE AVERAGES REFLECTING RAWS WINDS.
****

WAZ025>027-038-041>043-041530-
SOUTHERN (Zones 675 and 680) CENTRAL (Zones 677 and 682) AND NORTHERN (Zones 684 and 685) DISTRICTS.

.TODAY...
SKY/WEATHER.....PARTLY SUNNY WITH A SLIGHT CHANCE OF SHOWERS OR THUNDERSTORMS SOUTH...ZONES 680 AND 675 BY AFTERNOON.
TEMPERATURE.....MAX...88-95 VALLEYS AND 71-85 MOUNTAINS.
HUMIDITY.....LITTLE CHANGE. MIN...8-20% VALLEYS AND 10-30% MOUNTAINS.
WIND - 20 FOOT...
SLOPE/VALLEY..SOUTHWEST TO NORTHWEST 5-15 MPH WITH GUSTS TO 20 MPH.
RIDGE TOPS.....WEST WIND 6-12 MPH.
CWR.....00%.
LAL.....1/2
HAINES INDEX.....3-4 LOW.

.TONIGHT...
SKY/WEATHER.....PARTLY CLOUDY WITH A SLIGHT CHANCE OF SHOWERS OR THUNDERSTORMS...ZONES 675, 677, 680 AND 682.
TEMPERATURE.....MINS...54-64 VALLEYS AND 45-55 MOUNTAINS.
HUMIDITY.....POOR TO FAIR RECOVERY. MAX...40-60% VALLEYS AND MOUNTAINS.
WIND - 20 FOOT...
SLOPE/VALLEY..NORTHWEST TO SOUTHWEST 5-15 MPH WITH LOCAL GUSTS TO 20 MPH.
RIDGE TOPS.....WEST 8-15 MPH.
CWR.....00%.
LAL.....1/2
HAINES INDEX.....3-4 LOW.

.WEDNESDAY...
SKY/WEATHER.....PARTLY SUNNY WITH A SLIGHT CHANCE OF SHOWERS OR THUNDERSTORMS...ZONES 675, 677, 680, AND 682.
TEMPERATURE.....DOWN 2-4. MAX...84-93 VALLEYS AND 70-83 MOUNTAINS.
HUMIDITY.....LITTLE CHANGE. MIN...8-20% VALLEYS AND 10-30% MOUNTAINS.
WIND - 20 FOOT...
SLOPE/VALLEY..SOUTHWEST TO NORTHWEST 5-15 MPH WITH GUST TO 20 MPH.
RIDGE TOPS.....SOUTHWEST WIND 6-12 MPH.
CWR.....00%.
LAL.....1/2
HAINES INDEX.....3-4 LOW.

3-5 DAY EXTENDED FORECAST...THURSDAY THROUGH SATURDAY- ALL DISTRICTS: PARTLY CLOUDY EACH DAY. A SLIGHT CHANCE OF SHOWERS OR THUNDERSTORMS OVER THE CASCADES AND BASIN THURSDAY. OVER THE NORTHEAST AND IDAHO A CHANCE OF SHOWERS AND THUNDERSTORMS EACH DAY. LOWS IN THE 40S AND 50S. HIGHS 75-95. DIURNAL WINDS WITH BREEZY DOWNVALLEY EVENING WINDS IN THE CASCADE DISTRICTS.

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6 TO 10 DAY OUTLOOK: SUNDAY JULY 15 THROUGH THURSDAY JULY 19:
NEAR NORMAL TEMPERATURES AND ABOVE NORMAL PRECIPITATION.

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Appendix: Human Factors Analysis

The investigation team utilized the Human Factors Analysis and Classification System (HFACS) to assess the impact of human factors issues on the performance of the personnel and management throughout the Thirtymile Fire incident. The results of this analysis are presented below.

1. **Sensory and Perceptual Factors**

   There were clear indicators throughout this incident of individuals with low situational awareness, possibly exacerbated by sensory or perceptual factors listed below.

   - Misjudgment of distance or time (expectation of rate of fire movement): For most of the day on July 10, the fire had moved relatively slowly with a few dramatic runs up the sides of the canyon. This may have led the entrapped crew at the deployment site into assuming that they would see the fire coming at the same rate they had all day. This might help explain how they were taken by surprise when the burnover occurred, even though they had over 45 minutes to prepare for a possible deployment.
   - Impaired visual cues: Mountainous terrain, curves in the road, a relatively tall and dense canopy, as well as the ever-present smoke, made visual tracking of the fire's progress difficult. Eventually, the smoke would prevent the air attack from identifying the eventual deployment site, further complicating the challenge.
   - Geographic disorientation: The crew did not know that the Chewuch River Road was a dead end road.
   - Attention management: There were three major and distinct attention management issues.
     - Fire management personnel were "surprised" by the explosive fire behavior in a riparian area. This occurred despite known 1000 hour fuel levels, temperatures at historic highs and relative humidity at historic lows
     - District and Forest personnel were not continuously aware of the changing nature of the fire throughout the day on July 10th.
     - The crew was not kept aware of the trainer/trainee relationship at any given time during the day, resulting in confusion as to who was acting in what roles. This may partially explain the IC's difficulties at the eventual deployment site.
     - At the deployment site, the crew's attention was "turned inward." The time and attention of experienced crewmembers was channelized almost exclusively on two non-fire issues. The first was keeping less experienced crewmembers calm and the second was the low key conflict between the IC/Crew Boss and two squad bosses about coming down out of the rocks. This occupied the crew leadership and lowered the vigilance level as the

fire approached and prevented any serious preparation from being accomplished at the site.

2. Medical and Physiological Factors

The single overwhelming physiological factor that impacted upon this mishap was fatigue caused by sleep deprivation. Recent research (Lamond and Dawson, 1998) points out that the loss of even a single night's sleep (25.1 hours of wakefulness) impairs decision- making and vigilance to levels comparable to a blood alcohol content of .10, suggesting that "moderate levels of sustained wakefulness produce performance (impairment) equivalent to or greater than those observed at levels of alcohol intoxication deemed unacceptable when driving, working, or operating dangerous equipment."

This may help explain a series of uncharacteristic lapses in judgment and the multiple violations of the 10 Standard Fire Orders and the 18 situations that shout "Watch Out" The investigation team attempted to reconstruct the sleep histories of key personnel on this incident. The team forwarded these data to Dr. James Miller of the USAF Warfighter Fatigue Countermeasures team at Brooks Air Force Base, where he ran the sleep data through a quantitative analysis to predict cognitive capabilities throughout the period of the mishap sequence. The report is attached to this HF analysis and some key considerations follow:

- DFMO: At the key point where the DFMO escorts and inbriefs NWR #6 at Action 103 (when they took the fire from the Entiat IHC), he has had less than 30 minutes sleep in the previous 24 hours (with little more than that the previous night). He remains unaware of the observation by the initial attack crew the night before that this fire would not be held and would "hit the ridge and get large." He considers the fire "basically a mop-up show." Due to his high fatigue level, the District Ranger orders him to get some rest, and he is therefore out of the loop for several key hours as events unravel later in the day.
- Entiat IHC Superintendent: When the Entiat IHC arrive at the Twisp Ranger station on the night of 9 July, they are at the end of a 30-hour period of little or no sleep. After bedding down for less than 30 minutes (no sleep), they are directed to the Thirtymile Fire where they work throughout the night. After being relieved by NWR #6 and bedding down a second time, they are awakened again after less than one hour and asked to return. The key here is that the Entiat IHC Superintendent's (Marshal Brown's) large fire experience and considerable judgment are incapacitated at this critical point by nearly 50 hours with little or no sleep. He is offered and declines incident command citing the complexity of the fire, but his interview made it clear that he felt that neither he nor his crew were in any condition to reengage the fire at this point. This makes the coordination and execution of the rescue operations at 1800 that night all the more impressive.
- NWR #6 Crew: On average, the NWR #6 crew may have gotten one to three hours of sleep while driving to the incident the night prior to the mishap. Most of the crew received the phone call around midnight the previous night and the crew

did not begin the drive to the Okanogan until after 4 a.m. on July 10th. They admit to being excited about the assignment with some crewmembers reporting no sleep and others periodic rest during the drive. None of this could be considered quality sleep. Once again, the effects on performance involve the key areas of decisiveness and vigilance, possible shedding some light on the actions of the crew.

3. **Knowledge and Skill**

Although documentation was inadequate to prove the training levels of all crewmembers was complete; knowledge and skill did not seem to play a significant role, with two notable exceptions.

- Wildland fire inexperience of Crew Boss/IC trainee: Several crewmembers expressed discomfort with the "fast tracking" of the crew boss trainee. In news releases after the event, he was quoted as saying he had "never lost a fire" and that "the hair on the back of his neck never stood up." In contrast other more experienced firefighters reported that they "knew we were in a Watch Out situation."
- Fire Shelter Deployment Irregularities: Mishap site analysis determined that several crewmembers did not follow procedure while deploying their fire shelter by (1) taking their packs inside the shelter, and (2) not deploying in the preferred position. This may have been a result of the relatively sudden onset of the blowup.

4. **Mission Factors**

There were several mission factors that contributed to the decisions leading up to the entrapment.

- Dispatch and Forest Management communications: The mishap investigation team was unable to completely document the flow of communication from the fire scene to District and Forest management. These critical pieces of information included:
  - The nighttime situation report from initial attack crew (Laughman) that the fire would grow and "we would not contain it."
  - The time lag between the first request for aviation support (0215) and the initial dispatch inquiry regarding the allowable use of the helicopter using the Chewuch River as a dip site.
  - General information regarding the deteriorating fire behavior and conditions.
  - How and why Engine 701 gets dispatched to the fire line on the afternoon.
- Lack of shared understanding of appropriate fire strategy and tactics: This led to a somewhat and ill-defined strategy of "keeping the fire east of the road if you can." Eventually, (due in part to significant curves in the road, which should have been obvious to local officials or anyone consulting a map) this put the NWR6 crew in front of the main body of a moving fire that was heading directly towards

the one and only escape route. In effect, this was an entrapment by design, but one that might have been avoided if there was a shared understanding of what was being attempted with the roadside strategy.

1. **Personalities and Safety Attitudes**.

   Safety is a stated core value in USDA Forest Service Fire and Aviation Management operations. This investigation found no intentional or flagrant disregard of safety standards. However, in a mishap where the vast majority of the standing Fire Orders were violated and all but a few "Situations that Shout Watch Out" were present, one must question the field level understanding or commitment to the stated core value. One crewmember, when asked about the apparent apathy towards the guidelines, responded, "everyone knows that these things (Fire Orders) are just guidelines and can't always be followed." This appears to be a good distance away from the stated management philosophy that "we don't bend them and we don't break them."

   - Contrasting personality traits: Crewmember testimony indicates that the IC was not a forceful leader and that may have impeded his ability to command the situation at the deployment site, especially when contrasted with the personality traits of the crew boss trainee and some of the squad bosses on site, who were described as more charismatic and outgoing.
   - Sociological factors (clustering at the deployment site): Interviews with key survivors of the deployment indicate that those who deployed in the rock scree area reconfigured to District affiliations (friends that they knew and trusted) even though they were technically assigned to different squads. This is common behavior in the early stages of group assimilation and likely accounts for the failure of some members who were fatally injured to respond to the direction of the Crew Boss to "come down out of the rocks."

2. **Risk Management**

   This entire event was characterized by ineffective risk management, specifically an underestimation of the risks associated with working in front of a moving fire on a day with historic high energy release components, high temperatures, low humidity, and unstable atmospheric conditions. No one associated with this fire gave it the respect it was due.

3. **Communications and Crew Coordination**

   Communication and crew coordination were hampered at multiple levels throughout this incident. Failure to conduct briefings at key points – particularly after the final break at the lunch spot and after arrival at the eventual deployment site – as well as a lack of assertiveness by individuals who did sense the dangerous conditions characterized the poor crew coordination in this situation.

The charts on the following pages highlight fatigue levels of selected individuals.

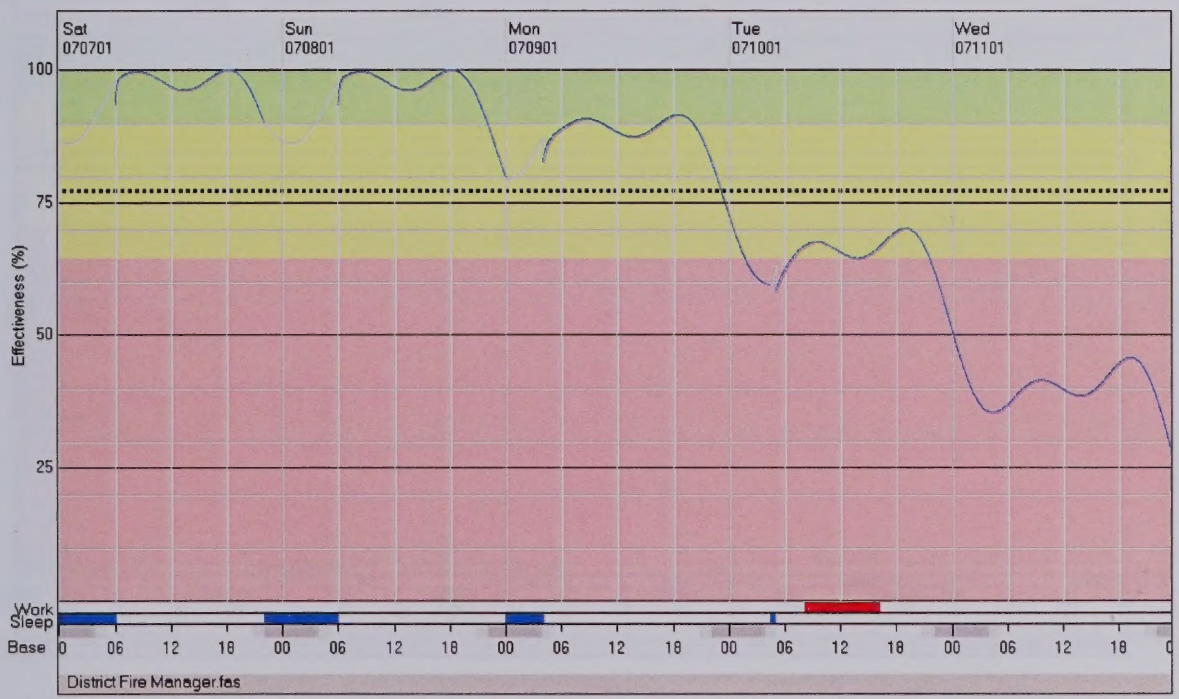
District Fire Manager Officer (FMO)

Schedule start: 00:00, 7 July 2001. Assume normal sleep through 06:00, 7 July.
Estimated sleep periods for nights beginning:

- July 7: unknown
- July 8: 00:00-0:400
- July 9: 04:30-05:00 "cat nap"

On 10 July 2001, predicted cognitive effectiveness was:

- 08:00-12:00: 67%
- 12:00-16:00: 65%



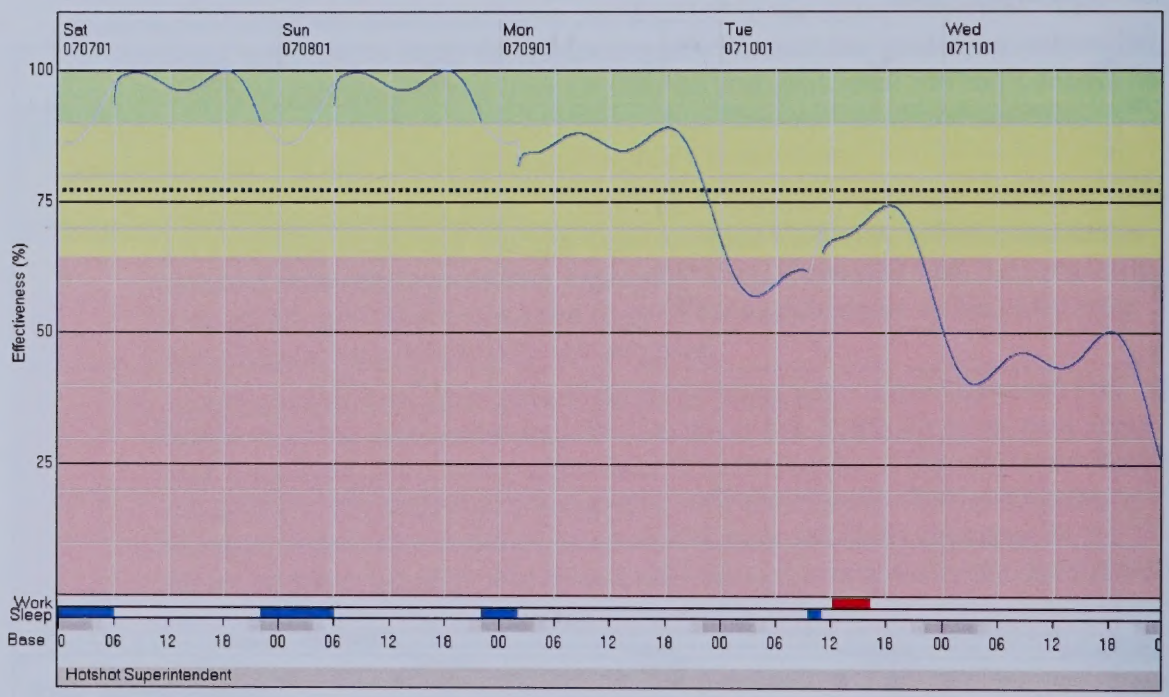
Entiat IHD Superintendent

Schedule start: 00:00, 7 July 2001. Assume normal sleep through 06:00, 8 July.
Estimated sleep periods for nights beginning:

- July 8: 2200-0200
- July 9: no sleep
- July 10: 0930-1100 nap

On 10 July 2001, predicted cognitive effectiveness was:

- 12:00-16:00: 69%



NWR-6 Crew

Schedule start: 00:00, 7 July 2001. Assume normal sleep through 06:00, 9 July.
Estimated sleep periods for nights beginning:

- July 9: 2200-0000

On 10 July 2001, predicted cognitive effectiveness was:

- 08:00-12:00: 80%
- 12:00-16:00: 78 %

Appendix: Equipment

The analysis of the personal protective equipment used in the area of the fire shelter deployment was accomplished by thoroughly examining the entire deployment area, describing, photographing and retaining the items found, and mapping the area using GPS. Temperatures were estimated by comparing the condition of items found to known effects of temperatures on various materials.

The area of the deployment is divided into two sites for the purposes of this report. The upper deployment area was located on a jumbled rock scree slope, 96 feet above the road. The slope between the road and the deployment site is 25%. The slope changes to 45-55% immediately uphill from where the deployment occurred. Rocks in the area ranged from 6 inches to many feet in diameter. Six firefighters, including the four fatality victims deployed shelters at this location. Two firefighters left their shelters after 2-5 minutes, one moving to a van on the road and the other moving to the river. Both survived, though one was severely burned.

The lower deployment area includes the dirt road along which 10 of the 16 entrapped people deployed fire shelters. Eight firefighters employed by the USDA Forest Service and two civilians, also trapped by the fire, survived the burnover in fire shelters deployed in this area. The civilians shared a single fire shelter with a firefighter deployed next to the road. The Chewuch River runs alongside this portion of the road, separated over most of the length of the deployment area by a small backwater and a sandbar. The van in which the firefighters arrived was parked at the edge of the road, on the side of the road closest to the river. The pickup truck driven by the two civilians was, at the time of the deployment, parked on the road at the upcanyon edge of the deployment area.

The Upper Deployment Area

Fire Shelters

The fire shelters were examined as they were found at the deployment site. It was not possible to identify with certainty the shelter used by each person who deployed in this area due to the circumstances involved in handling the fatalities. Only the shelter used by Thom Taylor was identified with certainty.

Five of the six fire shelters in the upper deployment area were seriously damaged, showing severe delamination. Conditions of the material indicate that four of the six shelters were exposed to temperatures in excess of 1200° F. Two of these shelters show damage indicating temperatures of at least 1600° F. These temperatures far exceed the protective ability of the fire shelter. Only a small piece of the fifth shelter was present for examination. The condition of this shelter indicated temperatures in the range of 500-800+° F.

The sixth shelter found in the upper deployment site was mostly intact. Conditions indicated temperatures generally less than 500° F. Dark brown scorch of the fiberglass under a hole located at the head end of the shelter indicated temperatures of at least 600° F. at that location.

Given the relative lack of damage to this shelter and the presence of melted nylon or plastic at the foot end, it is believed that Thom Taylor used this shelter, since Taylor's pack was located immediately at the foot end of his shelter and was severely burned. Taylor escaped after several minutes to the backwater immediately below the road. He survived with minor burns.

Line Gear Packs

Six line gear packs were found at locations identified as LG#1-LG#6 on Equipment Map # 2. All line gear packs in this deployment area were destroyed. Line Gear Pack #6 was located in the deployment site used by Tom Craven.

Tools

Two shovels with burned out handles were found in the upper deployment area. (SH1 and SH2 on Equipment Map #2).

Discussion of Upper Deployment Area

- All six of the firefighters who deployed in the upper deployment site deployed on large jumbled rocks 6" to 3' in diameter. Thomas Taylor and Jason Emhoff deployed in the rocks immediately uphill from the deceased. Both left their shelters after a few minutes and moved toward the river and road respectively. Both survived. There is evidence, based on interviews with these two individuals that the four fatality victims had already succumbed when Taylor and Emhoff left the area. This would imply that though the 6 firefighters were deployed very close to one another, the microsites where the two survivors deployed experienced less severe conditions than did those of the four fatality victims. Whatever protection Taylor and Emhoff had during the first few minutes after deployment, it allowed them to survive the initial lethal conditions so they could then escape to more moderate conditions on the road and in the river.
- The coroner reported that all four fatality victims died of asphyxia due to inhalation of superheated products of combustion. Thermal injuries were considered postmortem in nature.
- Due to the severe damage caused by the fire, it was impossible to determine the presence and prior condition of the personal protective equipment (PPE) worn by Jessica Johnson, Tom Craven and Karen FitzPatrick. Devin Weaver's PPE appears to have been appropriate and approved equipment. It is clear that the personal protective equipment used by three of the four fatality victims and the fire shelters used by all four victims were subjected to extreme temperatures and significant direct flame exposure, conditions that far exceed the design limitations of these products. The condition of Devin Weaver's clothing indicate that though the temperatures to which he was exposed were lethal, they were far lower than those to which the other three victims were exposed. It is possible that a large rock, immediately downhill from the site where Devin Weaver deployed offered some protection from the extreme levels of convective heat coming from below. However, holes between the rocks at his deployment site passed directly through to the unprotected area immediately downhill. Superheated gases may have passed directly into his shelter from below.

- Four of the six people who deployed in this area dropped their packs well below the deployment site. Tom Craven took his pack into his shelter and was likely exposed to extremely high temperatures when fusees inside the pack ignited. Fusees burn initially at 3500° F and then continue to burn at 1700° F. Thom Taylor left his pack outside, but adjacent to his own shelter. The heat from his fusees igniting and from his pack burning may have resulted in an increased heat load impacting Thom Taylor's shelter.
- Thom Taylor's use of gloves and a face/neck shroud protected him during the deployment and during his move from the deployment site to the river. Without gloves and a face/neck shroud, Jason Emhoff was exposed directly to severe heat conditions and suffered serious burn injuries. Use of these articles of personal protective equipment would have reduced the severity of his burns.
- Examination of an intact line gear pack after the event yielded 2 extra pairs of leather gloves. Firefighters should ensure that all personnel have necessary PPE. If not, efforts should be made to find equipment by asking other firefighters for extras.
- Rocky areas can be adequate deployment sites and have offered survivable deployment sites in past entrapments, but firefighters should be made aware of potential problems that can occur when deploying in rock:
    - It was apparent from discussions with Thom Taylor and Jason Emhoff, and from observations made at the site that it can be very difficult to obtain a seal with the edge of the fire shelter in large jumbled rocks such as those present at the deployment site. Firefighters must be warned that deployment on even surfaces can provide a better seal for the fire shelter.
    - Significant levels of downed fuel were present among the rocks at the upper deployment site and led to high convective heat loads when this fuel burned. Standing timber immediately below and immediately upcanyon from the deployment site created high levels of convective and radiant heat on the deployment site when they burned. Firefighters must be reminded to avoid all types of fuel, even when deploying in a rockslide.

The Lower Deployment Area

The ten people who deployed on or next to the road survived the burnover in fire shelters. They moved to the river and sandbar after the hottest part of the fire had moved through the area.

Fire Shelters

The fire shelters that were found on the road and in the river had all been deployed on or next to the road. Except in two cases, it was not possible to identify the shelter used by each individual since the shelters were moved more than once after the deployment took place. The individuals that used two shelters were identified by comparing the damage to the shelters with the experiences reported by those involved.

Five of the eight shelters deployed in the lower deployment site had little or no heat damage, indicating temperatures of <500° F. These shelters were all deployed on the road surface and had little or no direct flame contact. Three shelters did suffer minor to moderate heat damage.

Shelter #8 on Map #2 was used by Rebecca Welch (Deployment Site 9), Bruce Hagemeyer (Deployment Site 15) and Paula Hagemeyer (Deployment Site 16). It was deployed just off the road in brushy fuels. This shelter had delamination and torn foil damage on one side and on the foot end of the shelter. Temperatures in the area of the damage are estimated to have been 600-700° F. The heat damage to this shelter was caused by direct flame contact, which resulted from deployment next to brushy fuels. Tears present in the floor seams were likely caused by being pulled tightly over three people.

Shelter #11on Map #3 was used by Matthew Rutman (Deployment Site 13). This shelter was deployed between two line gear packs that had been dropped by other firefighters. The shelter was exposed to direct flame when line gear packs adjacent to shelter ignited. Nylon residue was found on both sides of the shelter. Delamination and torn foil damage to the shelter resulted from direct flame contact with the burning packs. Temperatures in the area of the damage are estimated to have been 600-700° F.

The final shelter deployed in the lower area showed some brown scorch on the sod cloth of the shelter. It appeared as if the shelter had been deployed directly on top of some fuel, which ignited and caused the minor scorch damage. It is not known who deployed this shelter or at which specific deployment site (in the lower deployment area) it was deployed.

Discussion of Lower Deployment Area

- All but two people discarded their packs prior to entering their shelters. Of the six packs that were discarded, 3 burned and 3 were mostly intact after the fire passed. Neither of the packs that were worn inside the shelters ignited, but both had fusees inside them that could have proven fatal had ignition occurred. It is recommended that firefighters be reminded of the importance of discarding packs with fusees prior to deploying a fire shelter.
- While six firefighters did discard their packs, some of these packs were left so close to the deployment sites they caused damage to at least one fire shelter and led to second degree burns on one individual when they ignited. Firefighters should be reminded of the importance of leaving packs well away from the deployment area.
- The road area was an effective deployment site. Temperatures in this area were less than 500° F. The presence of some intact polyvinyl bags on the road surface indicate that in some areas temperatures were less than 280°F, at least at ground level. Those firefighters who deployed in the road had a much less severe exposure to heat and flames than did those who deployed near brush and fuels at the edge of the road. Firefighters should be reminded of the importance of deploying shelters away from fuels of all kinds.
- Four of the eight people who deployed on the road had not pulled the tabs on their fire shelter bags half-way down prior to the deployment as was directed in a safety alert

issued in spring, 2001. One person (whose tabs **were** pulled prior to deployment) did tear a tab while opening the fire shelter bag. However, they had no further trouble opening the shelter with their gloved hands. It is clear that some people are not receiving or following the information in the safety alert that calls for all tabs to be pulled down half way until shelters can be rebagged with the improved bag system. Managers must ensure that firefighters receive important safety information.

Conclusions

- Face and neck shrouds offered protection to some of the firefighters involved in the deployment and reduced the severity of burns for one firefighter. Requiring shrouds as mandatory personal protective equipment for wildland firefighters could help prevent burns during escape or entrapment. Training in the use of shrouds is imperative so that personnel understand that they are to be used *only* in escape and deployment situations.
- Fire shelters used by people deployed on and near the road prevented serious burns and deaths. Fire shelters also allowed two individuals to survive the initial lethal conditions in the upper deployment area so they could then escape to more moderate conditions on the road and in the river. Though fire shelters performed as designed – as a reflector of radiant heat – they failed to adequately protect the four fatality victims from severe flame and convective heat contact. Development of a fire shelter that can better withstand flame contact must continue per the established protocol and timeline, (i.e. field use by 2003).
- It is critically important to avoid rocky areas near timber or other flammable fuels or where there is downed fuel among the rocks.
- Personnel should be cautioned that deploying shelters in rocks can sometimes make it difficult to obtain a seal to prevent heat, embers and smoke from entering the shelter. Personnel should be advised that an even surface such as a road will provide for a better seal than will an uneven surface.
- The importance of wearing gloves during deployment should be reinforced during fire shelter training.
- Fire shelter training should recommend deployment in flat areas rather than sloped areas if possible. Though it is not possible to describe every deployment situation, flat areas will tend to provide better protection from radiant and convective heat, all other conditions being equal. Training should be provided for known circumstances where this rule is not valid. All recommendations for avoiding draws, chimneys, saddles, fuels, and snags still apply.
- Personnel should be trained to use all available time if they are entrapped and cannot escape.
    - Shelters should be out and ready for deployment. Do not wait until the last minute.
    - Ensure that everyone has appropriate PPE for deployment, which includes: fire shelter, gloves, hardhat, boots, nomex, face and neck shroud. If any individual is

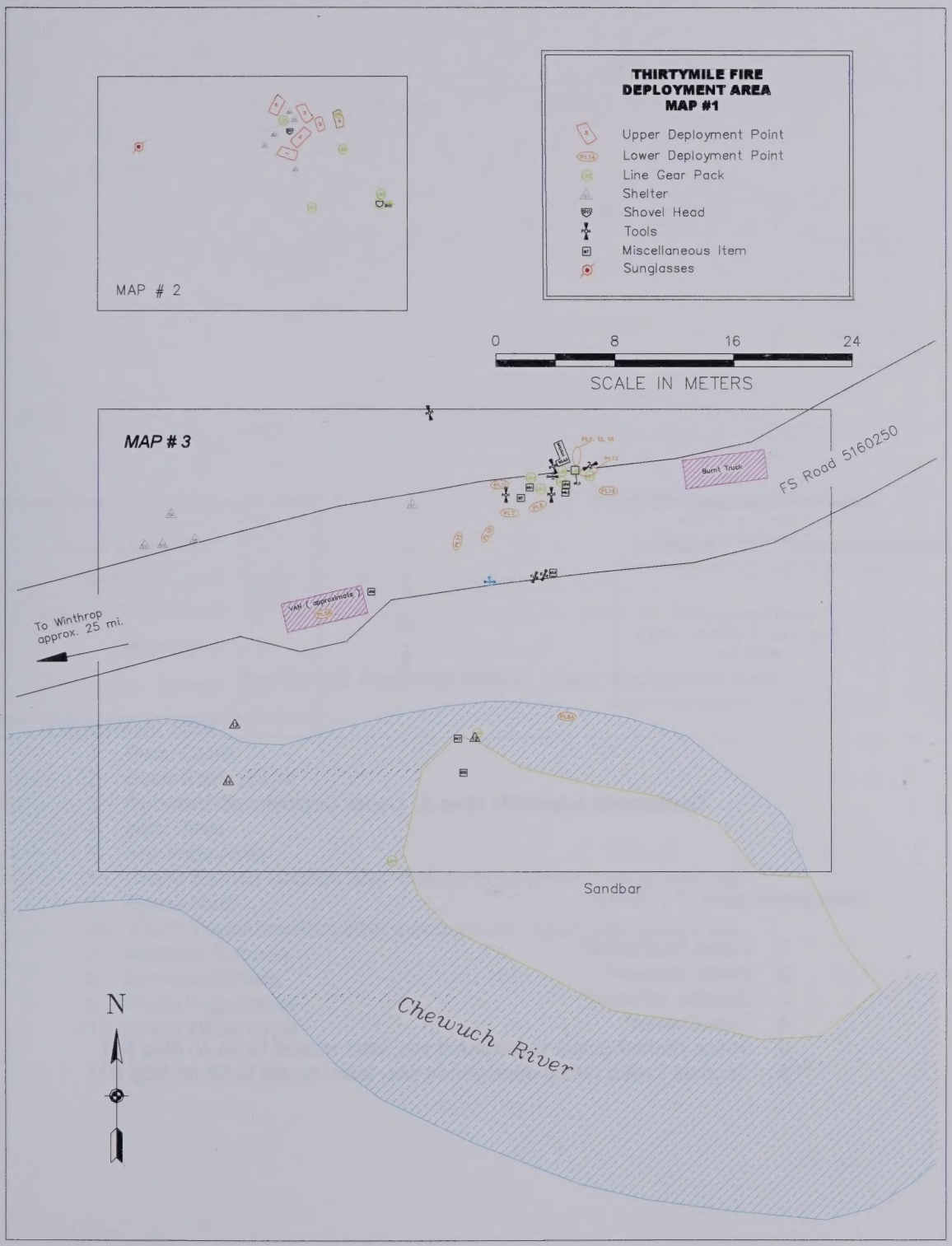
missing PPE, find replacement equipment; i.e. ask all other personnel for extra equipment.

- Identify deployment sites in advance; making sure everyone is aware of the location. Prepare the deployment site by clearing away fuels, burning out, etc. Entrapments do not often allow ample time to prepare for shelter deployment. If entrapped, use every available moment to make preparations for shelter deployment.

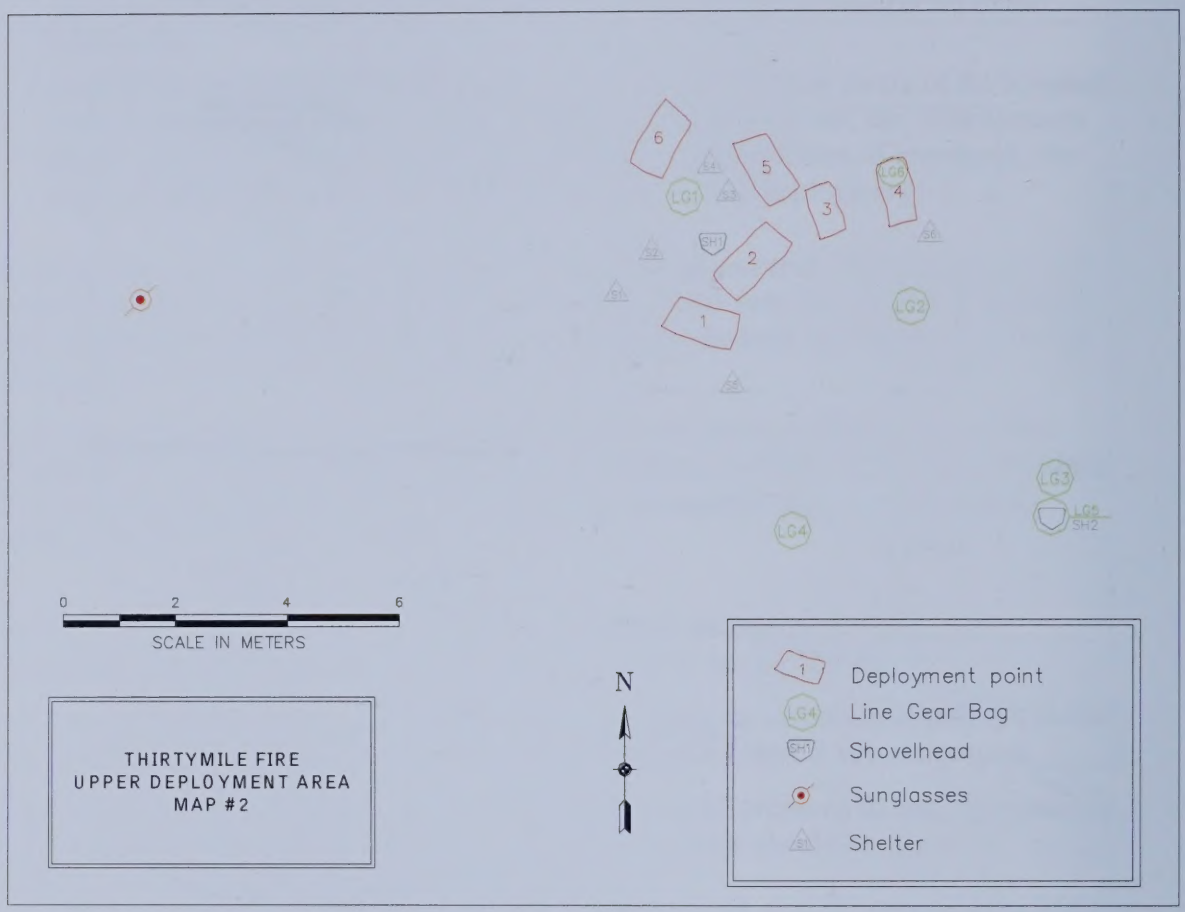
- Reinforce the need to place packs away from the deployment area. Packs may burn and expose shelters to both radiant and convective heat. Packs may also contain flammable and combustible materials that can be extremely dangerous both inside and outside of a fire shelter.
- Fire shelter training needs to be of the highest quality to stress the importance of this critical piece of safety equipment. Use of shelter training materials in the form of videos, brochures and pamphlets should be mandatory. Issue pamphlets to each firefighter during refresher training.

- Fire shelter training must be provided for all personnel and management should document how and when it was accomplished as well as the methods used.
- All fireline-qualified personnel should perform the 5 training scenarios as outlined in the training materials. These must be completed at least once before a fire assignment.
- Crews should carry 2-3 extra sets of PPE and shelters to be prepared in case equipment is lost or people arrive without needed equipment. Equipment should be stored in suppression vehicles (engines and crew carriers.)
- Discuss actions in the event of the arrival of unequipped personnel and/or civilians.
- Management must ensure that all personnel receive Safety Alerts and, if required, complete any action necessary to comply with the Safety Alert.
- A power point program should be developed that can be utilized for fire shelter training. The program would be web-based and would be located on the Safety and Health Working Team web site. It should present:

    - The most current information on fire shelters
    - Any current fire shelter issues
    - National statistics on shelter deployments and fatalities



Equipment Appendix Map 1. The Deployment Area



Equipment Appendix Map 2. Upper Deployment Area

Deployment sites: (* Fatality)

1. Karen FitzPatrick*
2. Devin Weaver*
3. Jessica Johnson*
4. Tom Craven*
5. Jason Emhoff (initial deployment site, later moved to 5a on Map #3)
6. Thomas Taylor (initial deployment site, later moved to 6a on Map #3)

Equipment Appendix Map 3. Lower Deployment Area

Deployment Sites:

1. Beau Clark
2. Scott Scherzinger
3. Rebecca Welch
4. Nick Dreis
5. Armando Avila

5a. Jason Emhoff location after moving from Upper Deployment site

6. Elaine Hurd

6a. Thom Taylor Location after moving from Upper Deployment site

7. Matthew Rutman
8. Ellreese Daniels
9. Paula Hagemeyer
10. Bruce Hagemeyer

Appendix: Qualifications

An analysis of the qualifications of the key personnel on the Thirtymile Fire was conducted based on a review of training records, class rosters, and annual reports. The following are the qualifications based on this analysis.

1. Between 1993 and May 2000 the Okanogan and Wenatchee National Forests followed NWCG PMS 310-1 as a guide for determining what formal training was needed. PMS 310-1 is less stringent than is the revised Forest Service Handbook 5109.17 (May 2000 edition) for fire training.
   - In order to become certified under this system, employees must complete "required" courses before consideration for certifying new ICS qualifications.
   - "Suggested" courses were not required for certification of qualifications.
   - Under this system there were no formal classes required for an advanced fire fighter (e.g., Squad Boss). Cravens, Taylor, and Kampen did not have S-211 (Water Use and Pumps) but were certified since S-211 was not required when they achieved their Squad Boss qualification.

2. After May 2000, the Wenatchee began implementing the revised FSH 5109.17.
   - Individual qualification reviews applying new requirements in revised FSH 5109.17, versus previous qualifications granted under PMS 310-1, have not been done.
   - The now required courses in revised FSH 5109.17 have not been formally waived to maintain individual qualifications gained under PMS 310-1.

3. The Wenatchee National Forest issued a taskbook for an ICS position after all formal required courses were completed.
   - In Pete Kampen's case, he was issued a taskbook before revised FSH 5109.17 was initiated. Kampen retained his taskbook and had trainee assignments while completing the formal training now required under revised FSH 5109.17.

4. Daniels took S-230 Crew Boss and completed his taskbook while on detail to the Redmond IHC in 1988.

5. Because Naches RD does not keep training records on temporary employees, they have been relying on class rosters and employee personal records to document training.

Northwest Regulars #6 Qualifications

Name	Assignment	Completed Required Training for Incident Position?	Completed Refresher or Basic 32 Hour Course?	Completed Work Capacity Training?
Ellreese Daniels	Crew Boss	Yes	Jun-01	Yes
Pete Kampen (1)	Crew Boss (T)	Yes	Jun-01	Yes
Nick Dreis	Firefighter	Yes	Jun-01	Yes
Elaine Hurd	Firefighter	Yes	Jun-01	Yes
Armando Avila	Firefighter/Squad Boss (T)	Yes	Jun-01	Yes
Brian Schexnayder	Squad Boss	Yes	Jun-01	Yes
Thom Taylor	Squad Boss	Yes	Jun-01	Yes
Mathew Rutman	Firefighter	Yes	Jun-01	Yes
Donica Watson	Firefighter	Yes	Jun-01	Yes
Emily Hinson	Firefighter	Yes	Jun-01	Yes
Dewane Anderson	Firefighter	Yes	Jun-01	Yes
Tom Craven	Squad Boss	Yes	Apr-01	Yes
Jason Emhoff	Firefighter/EMT	Yes	Apr-01	Yes
Jodie Tate	Firefighter/EMT	Yes	Apr-01	Yes
Karen FitzPatrick	Firefighter	Yes	Jun-01	Yes
Beau Clark	Firefighter	Yes	Jun-01	Yes
Scott Scherzinger	Firefighter	Yes	Apr-01	Yes
Devin Weaver	Firefighter	Yes	Jun-01	Yes
Marshall Wallace	Firefighter	Yes	Apr-01	Yes
Jessica Johnson	Firefighter	Yes	May-01	Yes
Rebecca Welch	Firefighter	Yes	Jun-01	Yes

Notes:
(1) Kampen was qualified as a Squad boss under PMS 310-1 in 1996. The Wenatchee Red Card Committee qualified Kampen as a Crew Boss trainee in May 2000, however the qualifications system changed in May 2000. Kampen kept his trainee status and was scheduled to complete the new required courses. Of the 9 required courses, 8 were completed. S-234 (Ignition Operations) overlapped with another training detail and was not completed prior to the incident.

Entiat IHC Qualifications

Name	Assignment	Completed Required Training for Incident Position?	Completed Refresher or Basic 32?	Completed WCT?
Marshall Brown	Superintendent/Night IC	Yes	Mar-01	Yes
Jason Lambert	Squad Boss	Yes	May-01	Yes
Chris Sotherlund	Firefighter	Yes	May-01	Yes
Ellis Thompson	Firefighter	Yes	May-01	Yes
Kyle Cannon	Asst. Superintendent	Yes	Mar-01	Yes
Jamie Sarabia	Firefighter	Yes	May-01	Yes
Josh Verellen	Firefighter	Yes	May-01	Yes
Jeff Steele	Firefighter	Yes	May-01	Yes
Matt Kennedy	Squad Boss	Yes	May-01	Yes
Kristian Mattson	Firefighter	Yes	May-01	Yes
Derrek Birks	Firefighter	Yes	May-01	Yes
Isaac Palmer	Firefighter	Yes	May-01	Yes
Mike Pipgras	Squad Boss	Yes	May-01	Yes
Zach Gormely	Firefighter	Yes	May-01	Yes
Alisha Glaesermann	Firefighter	Yes	May-01	Yes
Kory Mattson	Firefighter	Yes	May-01	Yes
Ben Spies	Firefighter	Yes	May-01	Yes
Taylor Wimberley	Firefighter	Yes	May-01	Yes
Amy Cram	Firefighter	Yes	May-01	Yes
Kerry Kelly	Firefighter	Yes	May-01	Yes

Methow Valley District Personnel Qualifications

Name	Assignment	Completed Required Training for Incident Position?	Completed Refresher or Basic 32?	Completed WCT?
Pete Soderquist	District FMO	Yes	Apr-01	Yes
Barry George	Asst. District FMO	Yes	Apr-01	Yes
Jack Ellinger	Suppressn. Spec./Duty Officer	Yes	Apr-01	Yes
Harry Dunn	Engine Supervisor	Yes	Apr-01	Yes
Dave Laughman	Engine Supervisor	Yes	May-01	Yes
Tim Schmekel	IA Crew Boss/IA ICT4	Yes	Apr-01	Yes

Management Evaluation Report

Thirtymile Fire

Chewuch River Canyon
Winthrop, Washington
July 10, 2001

September 26, 2001

Forest Service
U.S. Department of Agriculture

Accident Review Board

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File Code: 6730 **Date:** August 21, 2001
Route To:

Subject: Delegation of Authority
Thirtymile Fire, Chewuch River Canyon, Winthop, Washington
July 10, 2001

To: Tom L. Thompson, Accident Review Board

This memorandum formalizes your appointment as chairperson of the Accident Review Board to review and develop recommendations to prevent similar accidents in the future. The board is to be convened and is expected to complete its work by October 9, 2001. An extension may be granted based on valid justification.

Please contact and make arrangements with the following board members, advisors, and accident investigation team members as soon as possible.

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All travel and associated costs related to the board should be charged to HFPM42, with an Override Code of 1301. For additional information, please contact Caroline Deaderick, 703-605-0879, cdeaderick@fs.fed.us.

/s/ Clyde Thompson
CLYDE THOMPSON
Deputy Chief for Business Operations

cc:
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Official case file

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Preface

The Board of Review has accepted the Factual Report and findings of the Accident Investigation Team. The Board's Management Evaluation Report provides:

- A synopsis of the physical setting and summary of the events leading up to the accident.
- The causal factors generally arranged in the order which they occurred.
- A summary of the causal factors.
- Recommendations designed to prevent similar tragedies.

In the Board's evaluation, a further subdivision of the phases of the incident was made. The pre-entrapment phase identified in the Factual Report has been further subdivided to identify the preparedness, initial attack, and transition activities. Therefore, the causal factors are organized into the five phases of the incident:

- Preparedness, including pre-planning and readiness actions before the fire began.
- Initial decisions and initial attack actions.
- Transition, including the escalation of the fire to a higher level of complexity.
- Entrapment of firefighters and civilians.
- Deployment of fire shelters.

The Board found that these five phases lend context in describing this accident. They were, like links in a chain, inter-related with one another. Decisions and actions made early, in one phase, carried through to subsequent phases and often constrained decision options at the next phase. Eventually, they compounded and predisposed the tragic outcome that occurred on July 10, 2001.

Synopsis of the Thirtymile Incident

The Thirtymile Fire (Incident #103) began on July 9, 2001, as a result of an abandoned cooking fire during a period of high to extreme fire danger. In the days leading up to the incident, fire danger indicators were building toward record-setting levels. Several other fires were burning on the Okanogan-Wenatchee National Forest at the time the Thirtymile incident began, including the Libby South Fire, approximately 40 miles south. The Libby South Fire had grown to about 1,000 acres and, because it was threatening homes, had become a major focus of the Forest's fire suppression efforts.

The Chewuch River drainage, where the fire began, is a steep-walled canyon running southwest to northeast. A low pressure system was bringing a weak southwest airflow over the general vicinity. Although no wind events dominated the day's weather, the canyon and the gradient winds were in alignment.

The Thirtymile Fire started in a riparian zone next to the Chewuch River. Although the initial assessment of this fire from the air late on July 9th indicated its potential to become large, fire managers and those on the ground generally perceived it as a mop-up operation. It was a series of spot fires, with much of the general area unburned. In fact, today, much of the forest in the vicinity of the origin remains unburned and intact. However, the adjacent area, and particularly the area up canyon where the fire spread, burned intensely.

Firefighters from the Methow Valley Ranger District were assigned to initial attack. They were relieved by the Entiat Hotshots who continued the initial attack effort. This was the first change of command on the incident. The Entiat IHC had been working other fires and were tired when they arrived. The Incident Commander (IC) changed again in the mid-morning hours of July 10th, as the NWR #6 crew arrived. Part of this crew was dispatched in the middle of the night with little or no sleep. With the mid-morning change, incident command responsibilities were shared between the IC and a trainee. The IC maintained collateral duties as the Crew Boss.

The tactical suppression decision was to utilize pumps and hose as the means for control, but the water handling system was ineffective and a tactical change to construct hand-line was made. In the deep duff layers, and with the amount of downed fuel, construction of hand-line was hard. Spot fires and perimeter growth developed faster than the on site firefighters could contain.

About mid-day, two civilians drove by the fire up the canyon to the Thirtymile Campground. There was air support in the afternoon of July 10th, but the helicopter was delayed for several hours in providing support to the incident, partially due to a lack of clearance related to Endangered Species Act issues.

At mid-afternoon on July 10th, the Thirtymile Fire made a large run up the east slope above the Chewuch River. The IC, IC trainee, and the District AFMO acknowledged that they had lost the fire and that initial attack actions had failed. There was no direction from either the unit fire program managers on site and/or the IC to disengage, modify tactics, reestablish command, or

re-evaluate safe practices (including the selection of safety zones and escape routes). The overall situation was not reassessed for its potential. Even though the fire situation had significantly changed, firefighters continued tactics that were no longer viable.

Two engines arrived on-scene and proceeded up the road without checking in and without receiving a briefing. At the request of one of the engine supervisors, firefighters moved up the canyon to assist the engine in working spot fires. In this area, the fire had left the riparian zone and was in a drier habitat type, where fire potential was much greater. Combined with the rising temperatures and falling humidity, fire behavior increased considerably.

The firefighters assisting the engine crew with spot fires were up canyon and in front of the main fire, in the direction of the fire's spread. Their only escape route was the road. Between their location and the head of the main fire, the road became perpendicular to the direction of fire spread. It was here that the fire crossed the road and cut off the escape route. Fourteen firefighters and two civilians were trapped. Others had barely escaped as the fire crossed the bend in the road. Because of the drier fuel type, high intensity crowning developed, and the rate of spread picked up significantly.

The 14 firefighters retreated up canyon to an area they believed safe. Rockslides with only sparse fuels, the road, the river, and a sandbar provided a survivable environment. There was time to prepare for deployment, however, little preparation occurred. Shortly thereafter, two civilians trying to leave the area met the firefighters on the road.

Several of the firefighters were worried, yet there was not a collective sense of urgency to prepare for an impending crisis. Firefighters loosely formed into two groups; one on the road and the other on the rock scree. The firefighters on the rock scree were ordered to return to the road; however, these orders were disregarded. Several firefighters were anticipating watching the fire burn around them. Some were taking photographs. Few of the firefighters seemed to recognize they were in a life-threatening situation until the fire's heat suddenly hit their location and overwhelmed them. It was only then that they tried to quickly get into their fire shelters, as the command to deploy was given. No one deployed on the sandbar. Several went into the fire shelters with their packs on (contrary to established procedure), and one was without gloves.

Of the six firefighters who deployed on the rock scree, four perished. The ten others on the road below survived, including the two civilians that shared a shelter with one of the firefighters.

Despite the high fire danger and numerous compounding factors and accumulating events that characterized the Thirtymile Fire, the fatalities were preventable. At several points in the growth of this fire, decisions could have been made and actions taken that could have avoided this tragedy.

This Management Evaluation Report examines the causal factors that contributed to this accident, some of which were found throughout the incident. The display of the causal factors and the phases in which they were evident, illustrates the compounding effects of these actions.

These have clear and significant implications in terms of management oversight and supervisory control, at the preparedness phase, the initial action phase, and the transition phase. It also clearly illustrates that firefighter safety is influenced by individual behavior. Tragically, all ten of the Ten Standard Fire Orders were overlooked, ignored, or violated and critical time was wasted waiting for the fire and the danger to pass.

Causal Factors

A causal factor is any behavior or omission that starts or sustains an accident occurrence. For this investigation, the causal factors have been classified as either significant or influencing. They have been identified from the four categories of Factual Report findings (environment, equipment, people and management).

The causal factors on the Thirtymile incident are interrelated, and it is difficult to point to one causal factor or one finding as the most important. Additionally, several causal factors were identified from more than one phase of the incident. The five phases of the incident were determined to be:

1. Preparedness (Wildland and Prescribed Fire Management Policy; Implementation Procedures & Reference Guide; August, 1998; (WPFMP))

   "Activities that lead to a safe, efficient, and cost-effective fire management program in support of land and resource management objectives through appropriate planning and coordination."

   Examples include: activities done in preparation for fire season such as, annual refresher training, work capacity testing, review of plans and guides as well as fire equipment and personnel readiness checks.

2. Initial Attack (WPFMP)

   "An aggressive suppression action consistent with firefighter and public safety and values to be protected."

   These are the actions taken by the first resources to arrive at a wildfire to protect lives and property, and prevent further extension of the fire.

3. Transition (from the Fireline Handbook, NWCG Handbook 3, PMS 410-1; pp 18 & 24)

   Transition to the next level of management is expected and required when it becomes apparent that the assigned resources will not meet containment objectives in the expected time frames and/or the fire escalates to another level of complexity.

4. Entrapment (Glossary of Wildland Fire Terminology; NWCG, 1995; (GWFT))

   "An entrapment is a situation where personnel are unexpectedly caught in a fire behavior related, life threatening position where planned escape routes or safety zones are absent, inadequate, or have been compromised. An entrapment may or may not include deployment of a fire shelter for its intended purpose."

5. Fire Shelter Deployment (GWFT)

   "The removing of the fire shelter from its case and using it properly for protection against fire."

Significant Causal Factors

The causal factors determined to be significant in this management evaluation report are listed below with identified finding category and incident phase, in relative order.

Inadequate Safety Consideration (Management)

Phases of the Incident: Preparedness, Initial Attack, Transition, Entrapment, & Deployment

The safety considerations were not appropriate to respond to the current, potential, and subsequent fire conditions on this incident. All 10 Standard Fire Orders and 10 of the 18 Watch Out Situations were violated or disregarded during the incident.

Lack of Situational Awareness/ Inaccurate Assessment (Management)

Phases of the Incident: Preparedness, Initial Attack, Transition, Entrapment, & Deployment

At critical points throughout the incident the lack of situational awareness by key incident, district and forest personnel led to inaccurate assessments of fuels, fire behavior, and fire potential.

Fatigue (Management)

Phases of the Incident: Preparedness, Initial Attack, Transition, Entrapment, & Deployment

Work/rest cycles for incident and fire program management personnel, both at the forest and district levels were disregarded resulting in mental fatigue. This significantly degraded the vigilance and decision-making ability of those involved.

Command and Control (Management)

Phases of the Incident: Preparedness, Initial Attack, Transition, Entrapment, & Deployment

Failure to maintain clear command and control resulted in poor risk management and inhibited decisive actions, which contributed to the entrapment and deployment of shelters.

Strategy, Tactics, and Transition (Management)

Phases of the Incident: Initial Attack & Transition

The suppression strategy did not adequately consider objectives, fuels, fire behavior, and fire potential, nor the capability, availability and condition of the suppression resources. This led to the selection of tactics that could not succeed. As the fire complexity changed significantly and initial attack was unsuccessful, there was not a corresponding change in strategy or tactics.

Fire Behavior (Environment)

Phases of the Incident: Preparedness, Entrapment, & Deployment

A variety of environment factors supported the development of a crown fire, growing from a few acres to several thousand acres on the day of the accident:

- Valley bottom and slope fuels were dense with abundant ladder fuels.
- The moisture content of the fuels was at historically low levels.
- The combination of extremely low relative humidity, high temperature, and atmospheric instability created weather conditions conducive to the rapid movement, growth, and intensity of the fire at the times of entrapment and deployment.

Failure in Road Closure and Area Evacuation (Management)

Phase of the Incident: Initial Attack

The entrapment of two civilians was due to the failure to close the road and to subsequently evacuate the upper valley in a timely fashion.

Management Intervention (People)

Phase of the Incident: Transition

There were missed opportunities for intervention by management personnel on this incident. Leadership's failure to respond to concerns and observations by key individuals exacerbated circumstances that led to the entrapment.

Lack of Escape Routes and Safety Zones (People)

Phase of the Incident: Entrapment

Given the rapidly increasing fire intensity and changing fire situation, adequate consideration was not given to identifying escape routes and safety zones.

Failure to Prepare for Deployment (People)

Phase of the Incident: Deployment

Leadership of the entrapped firefighters failed to utilize available time and resources to coordinate and prepare crewmembers and civilians for shelter deployment.

Deployment Site Selection (Equipment/People)

Phase of the Incident: Deployment

Site selection for the deployment of the shelters above the road contributed to the four fatalities. The rocky nature of the deployment site made it difficult to seal out the superheated air. The large size and the arrangement of the rocks made it difficult to fully deploy the shelters.

Personal Protective Equipment (Equipment/People)

Phase of the Incident: Deployment

The improper use of personal protective equipment (PPE) contributed to injuries. Three people occupied one shelter. This exceeded the design capacity (although providing shelter protection of the two civilians was appropriate and justified by the emergency). One crewmember and the two civilians did not have gloves; other crewmembers did not wear their gloves. Some of the line gear that was left close to the shelters ignited, and there was burning vegetation close to and under the shelters.

Sudden Up Canyon Extreme Fire Behavior (Environment)

Phase of the Incident: Deployment

The dense forest and the strong fire-induced winds on the eastern canyon wall contributed to intense spotting, causing the fire on the canyon floor to intensify suddenly and surge over the deployment area.

Heat from Fire (Environment)

Phase of the Incident: Deployment

The fatalities were caused by inhalation of superheated air and exposure to high levels of radiant and convective heat. The presence of burnable fuels around and under the chosen deployment sites also contributed to the fatalities and injuries. The higher temperatures of the rock scree slope made conditions worse for deployment than conditions on the road.

Influencing Factors

The causal factors determined to be influencing by the Accident Review Board are listed below with identified finding category and phase of the incident.

Over-extension of Fire Personnel (Management)

Phase of the Incident: Preparedness

Unit fire personnel were over-extended. Although weather and fuel conditions were near historic highs and there was significant fire activity on the forest, additional fire program management personnel and additional initial and extended attack resources were not readily available.

Development of Crew Cohesion (Management)

Phase of the Incident: Preparedness & Deployment

There were a number of issues that limited the development of crew cohesion for the Northwest Regular #6 crew. These included: collateral duties of command, fatigue, incident complexity, lack of opportunity to work together, and management effectiveness.

Ineffective Water Operations (Equipment/People)

Phase of the Incident: Preparedness & Initial Attack

Water operations, both aerial and ground based, were ineffective, or delayed during the initial suppression actions.

Helicopter Delay (Management)

Phase of the Incident: Preparedness & Initial Attack

Assignment of a helicopter to the incident was delayed. This may have reduced the effectiveness of suppression actions. The lack of a clear process and determination of responsibilities to deal with Endangered Species Act issues contributed in part to this delay, as did dispatch actions and confusion associated with availability.

Organizational Relationships (Management)

Phase of the Incident: Initial Attack, Transition, Entrapment & Deployment

Unclear organization relationships among forest, ranger district and incident personnel reduced management effectiveness on the incident.

Summary of Causal Factors

In the late afternoon of July 10, 2001, the Thirtymile Fire on the Okanogan National Forest resulted in the fatalities of four firefighters and serious injuries. This resulted from the entrapment of 14 firefighters and two civilians, and their subsequent deployment of 14 fire shelters. The investigation identified a number of interconnected probable causes that must be addressed by the USDA Forest Service. Understanding the probable causes and taking all possible action to prevent similar happenings in the future is a critical concern for not only the Forest Service, but also for other Federal, State, and local government fire suppression organizations who must learn from these unfortunate and tragic happenings.

Intrinsic to forest, brush, and grass fires are many potential hazards and risks. Ensuring that firefighters are properly trained, and that policies, orders, and procedures are followed is the only way an organization like the Forest Service can deal with those hazards and risks. Over the years, lessons in how to safely fight forest fires have been learned and have resulted in new technology, fire organization improvements, availability of protective equipment, and expanded knowledge of fire science. These lessons have culminated in the last decade with major development and revision of federal wildland fire policy and a significant increased emphasis in firefighter and public safety. Unfortunately, increasingly dangerous fire conditions and expanded complexity of dealing with human factors such as leadership, experience, accountability, complacency, and fatigue continue to offer troubling challenges.

The lessons to be learned as a result of the fatalities on the Thirtymile Fire in July 2001 are mostly about what was not done that should have been done. There were many opportunities to prevent these fatalities. Accepted firefighting safety procedures were not followed. As a result, four firefighters lost their lives.

The most basic fact is that the four fatalities occurred because of inhalation of superheated air as a fast moving forest fire burned over fourteen firefighters and two civilians.

The fatalities and several injuries all occurred during, or shortly after, deployment of fire shelters. Failure to deploy before conditions completely deteriorated, failure to follow directions to move to the most desirable deployment location on the road, and failure to deploy using the proper techniques, significantly contributed to the fatalities and injuries.

Twelve people are likely alive today because of fire shelter availability. However, four people died while attempting to gain protection. There had been a considerable length of time, approximately thirty minutes, to improve the likelihood of survival during deployment for all sixteen entrapped individuals; however, little was done until the very last moments.

The entrapment of 14 firefighters occurred because of a failure to recognize a rapidly deteriorating fire situation, the placement of firefighters in a vulnerable position, the lack of communication about critical information, leadership's ineffective control and command of

operations, and finally, and most critically, the failure to adhere to safety procedures and standard firefighting orders.

The entrapment of two civilians occurred because of a delayed closure of a potentially hazardous area and failure to successfully evacuate the valley upriver from the fire. Had the 14 firefighters not become entrapped, the two civilians likely would have been entrapped without access to fire shelters as the fire moved swiftly through the upper valley. There were no safety zones in the upper valley considering the intensity of the fire in the late afternoon.

The entrapment of firefighters and civilians was the result of a chain of interrelated events throughout the day, including the failure to recognize the deteriorating conditions and escalating fire activity.

Fatigue of nearly everyone involved on the incident from the time of initial attack to the time of deployment likely contributed significantly to failures in leadership, command, control, proper fire assessment and size-up, development of strategies and tactics, communication, and use of discretionary time.

The use of water on this fire at critical times was reduced because of an inability to fully utilize available pumps and an extended delay in getting a helicopter to the fire. Confusion and/or lack of clear understanding of processes necessary to deal with endangered species considerations on use of water from the Chewuch River for helicopter dipping contributed to the delay.

Strategies and decisions made on the Thirtymile Fire from initial attack to deployment did not appropriately reflect the extreme fire conditions that existed, nor did those decisions appropriately consider the diversity and complexity of fuel types in the valley bottom. Similarly features of the valley bottom and the lack of adequate safety zones influenced the final outcome.

Available training records confirmed that all key leaders on this incident were trained and qualified for their assignments.

Recommended Changes

The following recommended changes to avoid similar incidents are proposed for agency consideration and action, and as appropriate it is recommended that they be responded to with the involvement, understanding, and support of the interagency wildland fire community (National Wildfire Coordinating Group). These recommended changes should be considered in the context of this larger interagency perspective.

Situational Awareness, Assessment, and Transition

Ensure that fire program managers, fire-line supervisors, and firefighters have situational awareness, assessment, and decision-making abilities necessary to successfully and safely transition command from initial attack to extended attack on incidents.

Ensure that fire program managers and incident commanders have situational awareness, assessment, and decision-making abilities necessary to react to significant changes in fire danger thresholds.

Fatigue

Develop and fully implement a fatigue counter-measures program.

Incident Operations

Strengthen command and control performance of agency administrators, fire program managers, and Type 3-5 Incident Commanders.

Strengthen operating procedures to ensure accurate determination of complexity with proper alignment of resources to match the incident complexity and potential and requisite command and control.

Leadership

Critically review fire management leadership program on a national basis to ensure that all individuals in leadership positions, at all levels of organizations, have the skills and capabilities to unquestionably lead in a responsible way.

Develop and strengthen the annual preparation of firefighters for personal responsibilities and leadership.

Safety Management and Accountability

Improve fire program safety management by adopting and aggressively implementing proven components of a comprehensive safety program.

Equipment

Continue improvements in personal protective equipment to provide for firefighter safety.

Endangered Species Act Protocols

Clarify the relationship between the Endangered Species Act (ESA) and fire suppression actions to establish a coherent process that accounts for ESA requirements with respect to the full range of fire suppression activities.

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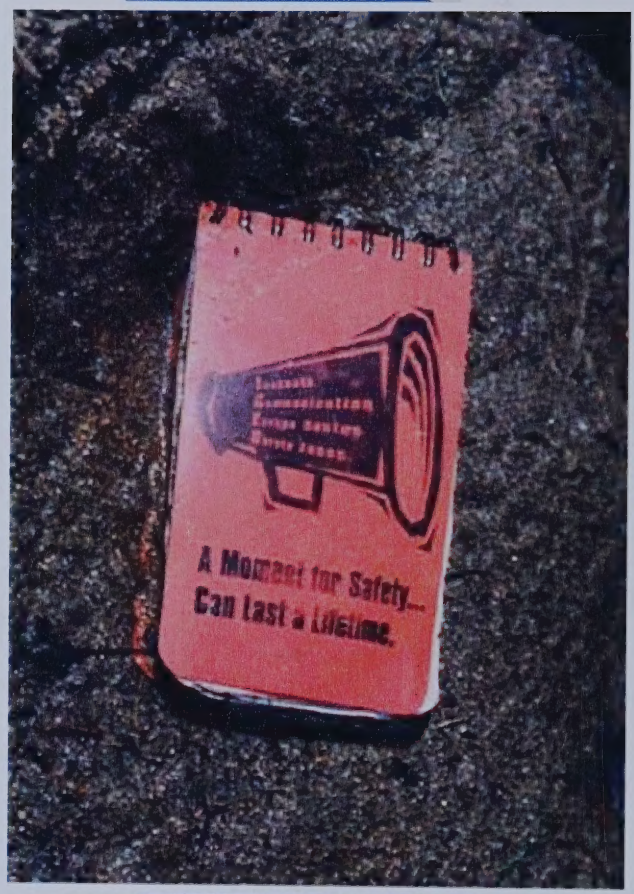

Thirtymile Fire Investigation

Accident Investigation Factual Report and
Management Evaluation Report